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Mr. Field and American Telegraphy. THE death of Cyrus W. Field removes the last of the four Americans to whom the science of telegraphy in its practical aspects was indebted for much of its early success. It need scarcely be said that the other three to whom we refer are Morse, Vail and Henry. No one of these four remarkable men made greater sacrifices for the cause of science than Mr. Field, and no one reaped a richer reward as the result of his labors. The laying of the first Atlantic cable was of course the crowning effort of Mr. Field's energetic life and upon that rests his claim to a place among the world's greatest benefactors. Men of Mr. Field's stamp have infinitely more to do with shaping the course of civilization for long periods of time than is generally attributed to them.

The Deadly Electric Wire Again. WHILE running some new lines on one of the streets of this city recently on which there is an elevated railroad, the locomotive became entangled with the wire, the end of which was lying coiled up in the street below. The dangling, wriggling wire dragging along the streets at the rate of 20 miles an hour soon caught up an innocent pedestrian and after tightening its grip around him it used the unfortunate victim like a large sling shot, smashing show windows with him, overturning the carts of street venders, and in general wrecking or trying to wreck everything that came in its way, until the engineer of the locomotive noticed the human battering shot and stopped his engine. There are many persons, such as professional objectors, a certain class of newspaper men, enemies to progress, men of the "I-told-you-so" kind, or such as have an ax to grind, and also those whose reasoning powers go no further than to tell them to eat when hungry or to cry when hurt—there are many persons of this class who will doubtless do as they have done before by making much of this accident and laying the whole blame on the deadly electric current, notwithstanding that the wire, although very lively, was really a dead one, just being strung up. It will be difficult, if at all possible, to convince these people that in this case, as in a number of others, electricity had nothing whatsoever to do with it. For their narrow minded theories and purposes it is sufficient that it was an electric wire and that damage was done, hence electricity must have done it. Had it been a barb wire, in which case it would probably in addition have sawed the unfortunate victim into several pieces besides sawing off legs and arms promiscuously among the pedestrians, the innocent electric current would likewise have had to shoulder the blame.

Storage Battery Roads in Large Cities. THE Second Avenue surface road of this city, running nearly the entire length of Manhattan island, and the Kings County Elevated Railroad in Brooklyn are taking steps toward changing their motive power from horses and steam to storage batteries. The former has obtained the consent of half the property owners (which is a mere formality for a storage battery system), and has applied for permission to use storage batteries instead of horses, while the president of the Brooklyn road announces that his company will soon make the change. More than this cannot be learned at present. Although such changes are never certain until they are actually made, it nevertheless looks likely now that the storage battery will soon have a chance in this city to show what it can or cannot do. No details can be had at present but there are indications that the alkaline battery may be used. A local paper gives this news under the caption "The Death Knell of the Trolley," but this idea is as absurd as it is short sighted. The overhead trolley system is an unquestioned success and has come to stay; there is a large field for it and it is going to hold its own no matter what progress the other systems make. There is a distinct field for both; the trolley system will be without any dangerous rival in small towns and in the suburbs of large cities, while the field for the other systems is in cities where valid objections are raised to the bare trolley wires. There is, therefore, really no rivalry between the two systems as they are not both equally well adapted for the same road. We are pleased to see this new enterprise which will again give the storage battery a fair trial, and we wish it success. But it appears strange that the storage battery should be introduced on an elevated railroad where many of its advantages over a side or central rail conductor are lost, and where its chief disadvantage, namely its weight, becomes of far greater importance than on surface roads. These points may have been considered by the promoters, but we hope no mistake is being made in an unwise application of the storage battery, as failure in this case would again check its progress as the recent patent litigation did in this city, both of which causes of failure are not justly attributable to intrinsic faults of the battery, although in the minds of those who do not know the real reason the battery must bear all the blame. The people do not look into the whys and wherefores of a failure, but naturally attribute it to the system in general.

Decision in Another Lamp Patent Case. THE Commissioner of Patents has reversed the decison of the examiners in-chief by deciding in favor of Swan and against Edison in their interference regarding carbons for incandescent lamps made of parchment paper and carbonized while in a bent condition. The case had been decided twice before, once in favor of Swan and then in favor of Edison; there will probably be no appeal taken. The interference issues were as follows: "First, a carbon formed from a straight strip of cardboard paper or parchment paper and bent to the form of an arch, hoop or loop, and carbonized by heat while in a bent condition; second, a carbon for an electric lamp made of carbonized parchment paper." In the decision the Commissioner calls attention to the fact that Edison did not apply for a patent until one year and seven months after he claims to have conceived the invention and seven months after Swan's patent had been issued. The Commissioner states that Edison had ample means and knew the importance of keeping accurate records, inferring by this that Edison ought to have applied for a patent instead of waiting until some one else had been granted one for the same thing. He furthermore seems to put little weight on the testimony supplied by the Edison witnesses, saying that their memories may be biased. He admits that Edison may have made the invention at the time stated, but adds that strong probabilities are against him. It is claimed by others that this decision will have little or no effect on the lamp industry, as it is for a process now no longer used. Edison's desire to gain the decision is said to have been merely a matter of personal pride. The decision is therefore of no general interest to the public except in so far that it points out the importance of applying for patents at once and not waiting too long after conceiving the invention. When an important invention is one for which there has been a need, it very often happens that several inventors conceive it about the same time, for as a rule there is more than one earnest worker in each field, and the one who succeeds first ought at least to apply for a caveat. There is rarely an excuse for not doing this. But there are doubtless patent attorneys and inventors who prefer the other method, namely, of recording some indefinite claims, making a few general sketches and having them dated and witnessed by their friends or business associates (all of which is more or less of a farce unless such records are kept in the Patent Office, where they cannot subsequently be altered), then waiting for another person to patent something similar in order that they may construe their records so as to cover what the other man has invented. We do not wish to intimate that this was done in the present case, but merely call attention to this practice and to the fact that the Commissioner in this case shows a tendency to decide in favor of the one who applied for a patent at once, and that he does not put much weight on testimony based on a mere claim of priority without unquestionable, tangible proof. No one can deny that such a decision is the most just, as there is little excuse except poverty why an honest inventor should not apply for a patent at once, or at the least file a caveat.

Fire Risks in Electric Lighting. FROM a communication sent to us by a prominent insurance company it appears that the fire underwriters are greatly disturbed by the increased fire losses said to be due to electricity. They claim that there is a great need of a better understanding of this matter by the fire underwriters, for under the present circumstances they say it is contemplated to charge for the use of electricity in a building, that is, to increase the rate where electricity is used. We are asked by them to solicit articles on this subject from those who have had experience in this field, and to publish as much information as possible for the mutual benefit of the insurance companies and those insured. Although we would not like to indorse the statement that fires are caused by electricity as often as has been claimed, yet we do agree with the insurance companies that the matter ought to be perfectly well understood and agreed to by both parties. It is evident that electrical conductors in a building can start fires if improperly laid, but it is just as certain that wires may be run so as to be perfectly safe. There are two things to be done: First, it ought to be determined as definitely as possible exactly what is safe wiring if properly installed, and what is not. The insurance companies ought to make their very best efforts in conjunction with the electric light companies to determine this in an impartial and thorough manner, and they ought to be just as careful not to make any unreasonable rules and requirements as to make those that are reasonable. This is evidently to their own advantage, for by requiring precautions which are unreasonable they will injure themselves, as the tendency of wiremen will be to object to and try to avoid the rules wherever they can. Secondly, having established such rules, they, as well as the owners of buildings, ought to see that these rules are rigidly adhered to and strictly enforced. This is, perhaps, even more important than the laying down of the rules, for, with any reasonably good method, there ought to be little danger if the work is well done. Unfortunately, the existing cut-throat competition among wiremen leads to underbidding, which results in a careless and inferior class of work. The best system, if improperly laid, may be of the most dangerous character. This is particularly the case in concealed work in which the wiremen have an opportunity to cover up defects, trusting that they will not be discovered by the inspector, and that they will get their money before a fire is started. It is for this reason that among all electrical artisans the wireman is, apparently, the most unreliable. In almost all other classes of work a mistake is discovered, and the responsibility can be placed, but if a fault in wiring causes a fire the wireman feels that he is safe, and that all proofs of carelessness have been destroyed by the fire, and he can safely say that it can not be proved to be a fault of his, that it was probably caused by water, by the plumber, or the carpenter's nail, or, if all other excuses fail, he attributes it to rats, as no one can deny that the rats did it. Assuming that wiring can be made safe, and there is no question about that, what is wanted most is a thorough understanding as to what the requirements are, and then to employ only such wiremen as have good reputations and whose aim it is to keep them and not merely to get their money. Giving the work to the lowest bidder is a very poor, short-sighted and dangerous policy in wiring a building. Give the work to the man who has a good reputation and is anxious to keep it, and then pay him enough to enable him to be conscientious. Careless, dishonest wiremen, such as many of them are, ought to be branded and then starved out of the business, as they are dangerous both to employers and the owners of buildings. When we are sick we do not employ the "lowest bidder" doctor; why then should we be less wise when our property instead of our lives is at stake? It is of interest alike to the electrical fraternity as it is to the insurance companies to see that the safest methods are adopted, provided they are not unreasonable, and then to make it compulsory that these should be properly carried out. Another possible way out of the difficulty is to let all buildings wired for electricity be insured among themselves, so that each one is more directly interested in the adoption of the safest methods. We solicit the views of our readers on this subject and would like to see the matter thoroughly ventilated in our columns.

Cyrus W. Field.

Our readers have already learned, through the announcement made in the news columns of our last issue, that the death of Cyrus W. Field occurred at his summer residence at Ardsley Park, near New York, on Tuesday morning of last week. His death was not unexpected, as he had been rapidly failing for some time, and the expressions of sorrow manifested on all sides were emphatic testimony of the public interest in the man whose greatest work had been the laying of the first successful Atlantic cable, a work that has never since ceased to be of untold benefit to the whole world. Nearly the whole of Mr. Field's remarkable life had been spent in the promotion of great public enterprises, but he was best known as the father of the Atlantic Cable, and his claims to greatness for the successful performance of this great undertaking have been thoroughly fixed in the memory of many a schoolboy of that day by the familiar lines in one of the school readers in common use a quarter of a century ago, on "How Cyrus Laid the Cable":

Bold Cyrus Field, he says, says he,
I've got a pretty notion
That I can lay a telegraph
Across the Atlantic Ocean.

Mr. Field's life was a strange mixture of fortune and misfortune. He was born in Stockbridge, Mass , on Nov. 30, 1819, and was the third son of David Dudley Field, a clergyman. He had three brothers, David Dudley, the distinguished jurist; Stephen J., a Justice of the Supreme Court of the United States, and Henry M., editor of the *Evangelist*.

The father of the projector of the Atlantic cable educated three of his sons at Williams College, but he was too poor to send Cyrus there. What book knowledge the lad had he picked up at the local academy and in desultory reading. He was 15 when he decided to come to New York to seek his fortune. He had $25, which he had borrowed from his father. His brother, David Dudley, obtained a place for him with A. T. Stewart. Cyrus was apprenticed to Mr. Stewart for three years, at a salary of $50 for the first year, $100 for the second and $200 for the last.

Mr. Field left Mr. Stewart's establishment to become a traveling salesman for Matthew Dick, a paper manufacturer in Lee, Conn. In 1840, just before he reached his majority, he went into partnership with E. Root in Maiden Lane. On the day after his twenty-first birthday he married Miss Mary Bryan Stone, of Guilford, Conn. In 1841, through rash speculations by his partner, Mr. Field's firm became bankrupt. He lost all, but he arranged with his creditors and started in business for himself.

In twelve years Mr. Field amassed a large fortune and retired from business. At that time he became the owner of the Gramercy Park house, in which he lived until his death. He was 33 years old then, and as he had all the money he wished, he determined to seek recreation, and he and an old friend, F. E. Church, the artist, made a year's tour through South America.

After his trip to South America, Mr. Field returned to New York in fair but not rugged health. His brother, Matthew D. Field, introduced him then to Mr. Fred D. Gisborne, of Newfoundland, believing that they might be of mutual benefit in pushing forward a new scheme for greatly shortening the time consumed in transmitting news between Europe and America. Mr. Field was reluctant to consider the project, and at first gave Mr. Gisborne no encouragement, but the enthusiasm of the latter finally won him to the idea. The Electric Telegraph Company, of Newfoundland, had been chartered to convey news by telegraph from New York to St. Johns, and thence by swift steamers to Ireland, the hope being that no more than five or six days would be needed to convey information from one country to the other. Mr. Field heard his guest with the characteristic courtesy and promised to think the matter over. After Mr. Gisborne retired Mr. Field took his globe and studied the route, and while thus engaged it occurred to him that instead of undertaking such a complicated plan as that proposed it would be far better to endeavor to stretch a wire cable across the ocean from the Newfoundland point to the Irish coast.

Mr. Field went to work at once to put his impressions to practical use. He submitted his plan to the approval of Peter Cooper, Moses Taylor, Marshall O. Roberts and Chandler White, who agreed to give their financial support to the enterprise, soon organized as the New York, Newfoundland & London Telegraph Company. His next years were typical ones in Mr. Field's vicissitudinous life—failure on the verge of success, despair on the heels of hope, ridicule swift after praise; long, unbroken, wearying suspense, varying with exaltation and depression, and the final triumph.

For all of the thirteen years of doubts, fears and hopes Mr. Field devoted his energy to the great enterprise of the new telegraph company. He visited England dozens of times, arousing confidence, soliciting aid, writing, speaking and consulting. After several unsuccessful attempts to lay the cable, communication was established first in 1858, a few messages were sent, and then the cable parted.

Undaunted by this failure Mr. Field again went to England in 1859 to make preparations for another attempt to lay the cable, Mr. Field's company had a nominal capital of $1,750,000, representing 350 shares of $5,000 each. Mr. Field himself subscribed $440,000. Great Britain granted an annual subsidy of $70,000, and the United States an annual subsidy of $70,000 for twenty-five years. Both governments granted the use of ships of war.

In 1865 the Great Eastern, in command of Capt. (now Sir James) Anderson, started to lay the cable. When the cable had been laid 1,200 miles from Valentia and only 600 more remained between it and Heart's Content it was broken by a sudden lurch of the vessel and sank two miles and a half into the ocean. Repeated attempts to bring the end of the cable to the surface failed. The enterprise was abandoned, but in the summer of 1866 it was resumed.

All honor was given Mr. Field after that notable July 27, when the work was finished. Congress voted him a gold medal and the thanks of the country. John Bright, in Parliament, called him "the Columbus of modern times." The Paris Exposition in 1867 gave him the Grand Medal.

In New York City Mr. Field is hardly less well known as the originator of the elevated railway system than as the man who laid the cable. He became interested in rapid transit for this city in 1876. He interested in his plan Samuel J. Tilden and several other wealthy men. In imitation of him other men put up competing lines and both systems were leased eventually to the Manhattan Company, from which Mr. Field retired in 1887.

Cyrus W. Field.
(From a painting by Daniel Huntington.)

Another of his enterprises in New York City was in connection with the *Mail and Express*. He purchased the *Evening Mail* from Dr. White, and two years later became owner of the *Evening Express*, and their consolidation was effected. Mr. Field's connection with the *Mail and Express* continued for two years more, when, in 1887, he disposed of the property to Elliott F. Shepard, its present proprietor.

Mr. Field was one of the most liberal benefactors Williams College ever had. It is owing to his generosity that Williams is surrounded by its beautiful and well-planned grounds. Mr. Field was not a college graduate, but his brothers, as mentioned above, all received their education at Williams.

On July 2, 1881, President Garfield and Secretary of State James G. Blaine had an engagement to dine with Cyrus W. Field at his Ardsley Park house. They were to be joined on the next day by the Rev. Henry M. Field, Justice Stephen J. Field and David Dudley Field. The six notable men were to pass a few few days at Williams College. It was while at the railway station at Washington when about to take the train for this trip that President Garfield was assassinated.

In 1874 Mr. Field visited Iceland to take part in the celebration of the one thousandth anniversary of the European settlement of that island On March 10, 1879, the twenty-fifth anniversary of the organization of the original cable company, he gave a reception at his house in Gramercy Park, at which many distinguished men gathered.

Mr. Field was a man of strong social inclinations, and long had considerable social ambition. At his house in Gramercy Park, next door to that of his brother, David Dudley Field, he entertained Lord Chief Justice Coleridge, who once spoke of him as "one of the very best types of the American man," and many other celebrated Englishman. He was a friend of Lord Palmerston, Lord Derby and Gladstone, and was acquainted with almost every man of note in English politics to-day.

In his last years Mr. Field was a quaint and familiar figure down town. Tall, slightly bent, with his white, full beard and his hair bushy behind his temples, he appeared in the street, summer and winter, in a long, black coat, peering keenly from under his heavy eyebrows at all who approached him. His face was alert, vigorous and searching yet with young men he was curiously amiable, patting them on the back, volunteering advice in a fatherly tone, and keeping closely his own counsel in a decided yet unoffending manner.

(From a steel engraving of 1858.)

With his wife Mr. Field was exceptionally happy. Much of his time in recent years he had passed with her near Dobbs' Ferry at his country seat, Ardsley, named after the manor house of the Fields, in Ardsley, Yorkshire.

On Dec. 2, 1890, Mr. and Mrs. Field celebrated their golden wedding at their New York city home, on Gramercy Park, where Mr. Field had lived for nearly 40 years, a neighbor of Samuel J. Tilden and Peter Cooper. Not quite a year later, on Nov. 23, 1891, Mrs. Field died at their country home at Irvington-on-the-Hudson. Mr. Field had seven children, one of whom died in childhood.

The portrait of Mr. Field, given at the top of this column, is taken from a painting by Daniel Huntington. The other portrait is taken from a steel engraving that appeared in one of the monthly magazines in September, 1858, and represents Mr. Field as he appeared at the time of the laying of the cable.

Earth Currents.

BY WILLIAM FINN.

The working of telegraph lines was again interrupted by earth currents on Tuesday, July 12. The first disturbance was felt about 1 P. M., and continued till 1:45 P. M. when it suddenly ceased. This was followed by a wave of apparently the same intensity at 3 P. M., lasting about 35 minutes. A measurement of the current strength taken during this period on one of the Eastern wires showed a maximum value of 22 milliampères. A third, though much milder disturbance, which lasted but a short time, was noted shortly after 5 P. M.

The only circuits affected in either case appeared to be those running east and west. The principal characteristic of the currents on this occasion consisted in the uniform direction of flow, the only fluctuations observed being in the strength of the currents. It was probably due to this fact that it was found possible to successfully operate one side of quadruplex circuits by abandoning polar or reverse current working, and connecting the neutral sides of the system together, a circumstance worth remembering for future guidance under similar conditions.

A magnetic storm of extraordinary severity and duration swept over the United States on Saturday July 16, almost completely paralyzing the entire telegraphic service of the country for several hours.

The writer had suspected the presence of abnormal earth currents in the wires on the morning of that date and was engaged in making observations and taking readings for several hours prior to the advent of the storm.

Between 8 and 10 A. M. more or less difficulty had been experience in operating several of the eastern and western circuits, and galvanometer tests had shown the existence of strong and variable earth currents in some of the wires.

From 10 to 11 A. M. continuous observations were made on a New York-Boston wire, on which the current showed incessant fluctuations both in direction and magnitude, averaging upward of 10 milliampères.

Several tests between 11 A. M. and 12 M. showed similar variations in the polarity of the current, though somewhat diminished in strength.

Between 12 M and 12:15 P. M. upward of 150 changes in the direction of the current had been noted on a New York-Providence wire, during which time the current averaged 9 or 10 milliampères.

Suddenly, at 1 .20 P. M., a tremendous wave struck the wire, which sent the galvanometer needle whirling around the scale and prevented further measurements being taken without the aid of a $\frac{1}{100}$ shunt. At the same instant every eastern and western circuit, as well as many wires in other directions, became either partially or wholly inoperative. A short while afterward there was scarcely a wire in any direction, except local ones, that did not feel its effects, though here and there the curious anomaly presented itself of a circuit being operated between two points, where other circuits between the same terminals were absolutely unworkable.

At 12.37 P. M. a reading obtained on a six gauge iron wire to Boston, 213 miles in length and measuring about 3,700 ohms, showed a current strength of 27 milliampères which increased to 32 milliampères two minutes later, and continued to grow in intensity until it finally attained the unprecedented magnitude of 133 milliampères at 12.40 P. M., representing a difference of potential between the two grounds of about 492 volts. This was the highest electromotive force observed in any of the subsequent tests, many of which, however, exhibited currents of higher values in the wires. For instance, the current strengths noted in a wire to Elizabeth, N. J., rose from 5 milliampères at 1.51 P. M. to 95 milliampères at 1.55 P. M., and finally to a maximum of upward of 150 milliampères at 2.10 P. M., with an estimated E. M. F. at that time of about 210 volts.

A wire to Philadelphia measuring 900 ohms exhibited a current of 140 milliampères, thus showing a potential difference of 126 volts between the distant grounds.

The writer knows of no record of any previous storm in which the voltage and strength of the earth currents ever attained so high a value. The nearest approach in point of intensity is probably the electric storm of Jan. 31, 1881, which developed a current of 41.4 milliampères in one of the London-Irish wires, the highest electromotive force observed being 120 volts on another wire between Haverfordwest and Valentia.

During the prevalence of Saturday's storm, it was found possible, as is usual in such cases, to converse, and even send business over the wires without the aid of the ordinary artificially produced signaling currents.

By 3 P. M. the disturbing forces had so far subsided as to admit of a resumption of working on most of the southern wires, as well as on several circuits in other directions.

About 4:15 P. M. another but less powerful wave struck the western wires, but did not appear to further affect other circuits, hardly any of which, however, was entirely free from interruption.

The storm continued to affect the wires at intervals more or less frequent, and with varying degrees of intensity, during the whole of the night, and did not finally disappear until the afternoon of the following day.

Sun spots are probably responsible for this latest extraordinary electrical manifestation, as they have been undoubtedly concerned in the production of similar phenomena in the past. The period of maximum sun spots which occurs

about every 11½ years has always been associated with disturbances of this nature ever since the advent of telegraphy. The present year falls in the midst of a period when sun spots are most numerous, and already 11 electrical storms have so far been recorded, viz.: Feb. 13, powerful and variable; March 6, comparatively mild; March 12, mild; April 24, 25, 26, slight and sporadic; May 16, strong; May 17, mild; May 18, very strong and exhibiting curious anomalies; July 12, strong but comparatively steady; July 16, very powerful and very variable.

Many of the principal characteristics of these storms have been recently presented to your readers, and it only remains to be said that it is generally believed by scientists that the tremendous eruptive forces in the sun during these particular periods disturb the electrostatic lines of force radiating from our electrically charged globe, and thus create the conditions necessary for producing those great differences of potential between various portions of the earth's surface, which give rise to abnormal earth currents.

R. L. Garner Will Introduce the Telephone and Phonograph Among The Monkeys of the African Forest.

Mr. R L. Garner sailed last week for England on his way to Africa, where he will continue his study of simian speech, making a special study of the gorilla and chimpanzee. His first investigations will be on a little peninsula almost directly under the equator and on the main land up to the Gaboon mission, 60 miles distant. From there he will proceed up the Gaboon River about 90 miles, then across the country to the Ogowe River about 30 miles. Thence he will follow the equator to the Congo River, about 600 miles from the coast. His object in making this inland trip is to find, if possible, the hut-building ape, whose language he wishes to study by the aid of the phonograph and the telephone. Regarding the preparations he has made for studying the social life and conversational capabilities of our Darwinian relatives Mr. Garner, a few days before starting on his trip, said :

"I will carry a year's supply of food. For experimental purposes I will take a phonograph, photo-camera, electric batteries, telephones, several miles of wire, flash lights, etc. The most important feature of my outfit is a steel cage, planned by me, without which the use of some of my implements would be impossible. The cage weighs about 500 pounds. It is made of steel wire woven into diamond-shaped lattices, with a two-inch mesh. The cage is provided with a canvas top and sides, the sides arranged after the manner of window curtains. On the floor is a rubber mat, which will keep the moisture from entering the cage from below, and will act as an insulator when the cage is charged with electricity. A couch and camp chair will complete the furnishing of the cage.

"The cage will be my house as well as my fortress when I am camping in the jungles. The battery that I carry will develop three volts of electricity for 300 consecutive hours. With it I will be able to flash my light at night, snap my camera, and operate my telephone and phonograph. The cage is so arranged that by means of an induction coil it can be heavily charged with electricity at a moment's notice. This will be a more effective way of keeping away prowlers and meddlers from it in my absence than posting a notice, 'Claws off.' With the aid of the flash light I intend to get views and pictures never before seen by savage or civilized man—nocturnal views of the great African jungle and forests at evening, at midnight, and at sunrise.

"I will be unable to induce a great many desirable specimens to come within speaking distance of my phonograph, but I have apprehended this contingency, and have devised a unique method of preventing the loss of these sounds. I have the phonograph so arranged that the telephone can be connected with its diaphragm. The other end of the telephone can be carried at random through the forests to the herding place of the animals. There it will be placed in the underbrush or trees. This end will be placed in a large tin horn, both the horn and telephone being painted a foliage green, so as not to attract the attention of the animals. In front of this horn will be placed baits and decoys, in order to get the animals to utter sounds in it. These sounds will, of course, be transmitted to the phonograph."

Illumination at the Recent Jubilee in Budapest.

BY JOSEF HERZOG.

The jubilee commemorating the twenty-fifth anniversary of the crowning of King Franz Josef the First presented a very good opportunity for some fine illumination effects, whose great splendor surpassed by far anything of the kind ever before attempted. It was another instance of rivalry between gas and electric light, in which the latter was decidedly the victor. The pen is not able to express the fairyland effect, neither will illustrations be able to do justice to the original. Innumerable objects were illuminated in numerous different ways, the finest of which, however, was the illumination of the river Danube. From the suspension bridge shone the milk white light of 30 arc lamps, and from the hills and roofs of high buildings enormous projectors sent their powerful beams of light, turning the whole into a sea of light. The fronts of large public buildings were illuminated with many thousand lights, both gas and electric, in addition to which there were innumerable candles arranged in rows in the windows of private houses. One of the finest illumination effects was that of the fountain at the Calvinplatz, which was illuminated with numerous colored incandescent lights, producing a very pleasing effect, and one which was apparently appreciated very highly.

Especially interesting was the large emblem, shown in Figs. 1 and 2, on top of the building of the electrical firm of Ganz & Co., representing the initial letters of their monarch, Franz-Josef der Erste. The 380 incandescent lamps radiated their light as if from heaven, the effect being especially fine on account of the dark background of the sky, the arrangement of the lamps being such that their light did not shine on the scaffolding, shown in Fig. 1, on which the lamps were secured.

But we will limit ourselves here to a description of some of the illuminated objects from a technical standpoint.

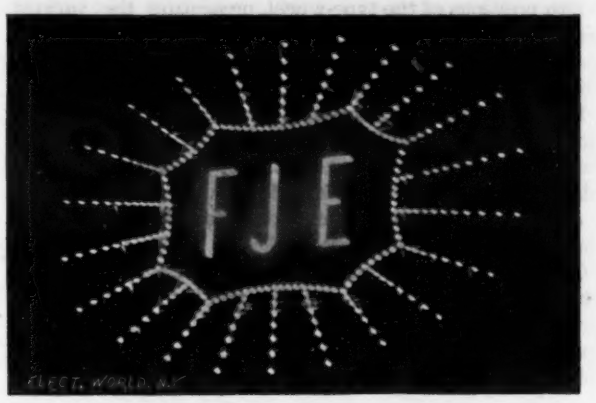


FIG. 1.

The method used in gas illumination is well known. The gas pipes have the advantage that they can be bent into any desired form, and therefore are well suited for illuminated designs or emblems. With the electric light three methods of illumination are used : First, with projectors, which is a very effective method, but is applicable only on very large open places, besides requiring that the projectors must be placed at some high and prominent point commanding the place to be illuminated. Secondly, illumination with arc lamps ; in order to produce a striking effect they must be arranged in very large numbers, much more so than in ordinary street lighting, and they must be of great candle power. To attempt to make outline designs with arc lamps is very difficult and unsatisfactory. Thirdly, illumination with incandescent lamps; with these the finest and most striking illumination effects can be produced. They have the advantage, like in gas illumination, of being easily attachable to any outline designs. The absolute steadiness of the light is very imposing and gives a much finer effect than the flickering gas lamps, which in windy weather give only an imperfect and blurred picture of the intended design.

The very striking design shown in Figs. 1 and 2 was about 100 feet wide and 65 feet high. In order to secure

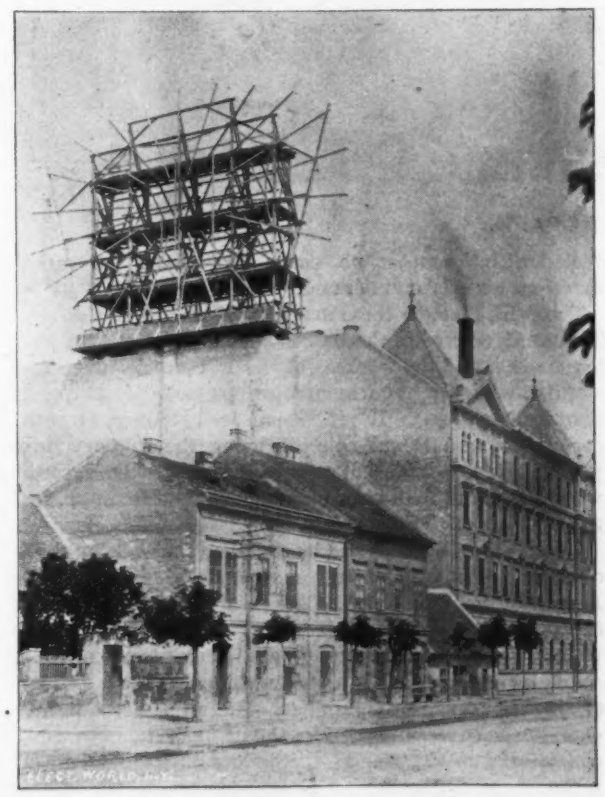


FIG. 2.

the frame to which the lamps are attached, a large scaffolding was erected 65 feet high and 50 feet wide. Altogether there were 380 lights ; in the letters themselves there were 111 lamps of 15 c. p. with small reflectors, while in the rays 172 lamps of 10 c. p. were used without reflectors. The height of the letters themselves was about 16 feet. The whole presented a very fine effect, and could be distinctly seen from a distance of 2½ miles.

Another very successful illumination was that of the front of the main railroad depot, which was outlined with 1,500 incandescent lamps of 10 c. p. 16 inches apart.

Statistics Concerning Accidents to Human Beings from High Tension Electric Currents.

Dr. Lacassagne, professor at the medical college of Lyons, France, is about to make some researches on the physical and medical effects of electricity at high tension, in preparation for which he is collecting statistics from the superintendents of electric lighting stations and others, asking for answers to certain questions. From the answers to these he expects to make deductions which will doubtless be of interest and value to the medical profession, and can hardly fail to be so to the electricians also. The French are well known for their work in this field, in which they have doubtless done more than the medical profession of any other country. The method adopted by Dr. Lacassagne of first collecting as many facts as possible before making any theories, is certainly to be recommended as the most rational; but such a method requires for its success the co-operation of many individuals who possess the data concerning accidents of this kind, and we hope that our readers will aid the cause by answering as fully as possible the questions given below, and send the information either to us or to Dr. Lacassagne, whose address is Quai Claude-Bernard, Lyons, France.

The questions he asks are as follows :

I.

(*a*) Has there been any accident in your factory or station to a member of your staff through contact with a conductor?

(*b*) Was it fatal at once, or were the injuries slight? What was the nature of the injuries, and the consequence therefrom?

(*c*) Under what circumstances did the accident take place? What part of the body was in contact with the wire? Did the two hands touch two conductors of different potential, or did the discharge pass through the body from the hands to the earth, the victim having been standing on wet ground?

(*d*) What was the potential of the conductor which was touched?

(*e*) Did the victim make any outcry? Did he fall, or was he unable to release his hold? Did he lose consciousness?

(*f*) What were the impressions at the moment of discharge? Was there a flash of light in the eyes? A buzzing in the ears? A pricking sensation over the body as if caused by needles?

(*g*) What treatment did he receive afterward? Was a physician called?

(*h*) What were the consequences of the accident, whether burns, and where located? Were the burns on any other part of the body than at the points of contact?

(*i*) Did he faint, and, if so, for how long a time? Was he able to walk after the accident? Did he feel any hindrance to movements or to respiration? Was there a tendency to lumbago? Was there pain in any muscles? Headache, dizziness or nausea?

(*j*) Did the effects last any length of time and confine him to his bed? Was there any paralysis of the limbs, or in the face subsequently to the accident? Was his memory or his mental faculties injured? was there any lameness in his muscular action? Did it cause any feebleness characterized by loss of sleep, of energy, of appetite, accompanied by nervousness and irritability?

(*k*) Were there any other consequences which were due to the shock, such as troubles with the sight or with the hearing, or in the acuteness of the sense of touch?

II.

(*l*) What was the potential of the conductor touched at the time of the accident?

(*m*) What was the intensity of the current?

(*n*) Was it an alternating or direct current? If the former, what was the number of alternations per second at the ordinary speed of the dynamo?

(*o*) Was the conductor which caused the accident bare, or had it lost its insulation?

(*p*) Was the current which caused the accident that from the dynamo directly or from a transformer?

Transporting Electric Energy in Accumulators.

In the early days of the accumulator it was suggested to serve charged accumulators to the houses in a city in the same way in which milk, ice, and other commodities are served, but it was soon found that it was impracticable. Wherever a building is near enough to a central station to be connected with it by wires, the use of accumulators brought to the houses charged is of course a much inferior and much more expensive system. But there are certain cases outside of the reach of central station mains where such a system is said to be practical now, since the accumulators have been improved sufficiently to stand such rough handling.

A company has just been formed in Vienna with the idea of supplying electricity in this way. The wagons for supplying accumulators make regular trips through the environs of Vienna. According to our contemporary *Elec tricité* the cost of the current supplied in this novel manner is as follows:

1. For a battery of accumulators running two lamps of 16 c. p. for five hours a day, about $7 per month.

2. For four lamps of 16 c. p. running for five hours a day, about $10 per month.

3. For six lamps of 16 c. p. running for five hours a day, about $12.50 per month.

The batteries are changed every day, but in order to be

sure that the service is not interrupted two sets of batteries are left in the houses continually.

The cost of wiring in these houses is said to be at the rate of $4 to $5 per lamp in addition to the cost of the lamps themselves.

The American Type Telegraph.

Printing telegraphs are almost as old as the electric telegraph itself. House, Hughes, Phelps and others followed quickly in the footsteps of Morse, with devices for supplanting the Morse character with the Roman letter. In some countries they almost succeeded, and, to this day, continental Europe does a large amount of its telegraphing by means of the Hughes printing telegraph. In England the Hughes machine was extensively employed by the old companies and was only abandoned after the telegraph had been absorbed by the government.

In this country there was once a House telegraph line using that system exclusively, and the Western Union Company has for years transmitted press and other telegrams between Boston, New York, Philadelphia, Baltimore and Washington by means of the Phelps improved "motor printer" with success, and at a rate of speed far exceeding that of the Morse.

One of the chief objections to nearly all of the printing telegraphs in the past has been the "form" of delivery, their messages being printed on a narrow band of paper or "tape." A press dispatch of a few hundred words would be many feet in length and liable to kinks, breaks and entanglement. Users of the telegraph have always objected to receiving their dispatches on a ribbon, and many have refused to accept them by the yard, asserting that filing with safety was impossible, and that portions of messages were frequently lost. As a result, all dispatches received by the printing telegraph in Europe are now torn into short lengths and clumsily pasted on ordinary delivery blanks. The tearing and fouling of the tape in the basket of the ordinary ticker is familiar to all, often rendering a backward search for some particular item of news impossible.

The American type telegraph machine has been designed with a view to overcoming this and many other objections to printing telegraphs as they have heretofore existed. By means of this apparatus the delivery is in the form of a printed page, eight inches wide. All the letters, numerals, fractions and other signs necessary to ordinary typewriting are provided. The receiving instrument is entirely automatic in its action, requiring no skilled operator to watch or adjust it. The transmitter is similar in form, as far as the arrangement of the keys is concerned, to the typewriter, and can be worked by any person familiar with that instrument. The transmitting operator, by means of his keyboard, has full control of the machine at the distant end of the line, and can vary the length of a printed line or the space between two items of news, or two telegrams, at will.

Electrically, this instrument has been designed with the object of relieving the electromagnets which are operated or connected with the main line of as much work as possible. This object is accomplished by the use of a suitable motive power (a small electric motor), independent of the magnets, for effecting the mechanical operation of the several parts of the printing and feed mechanisms and by utilizing the electromagnets merely for releasing, arresting and generally for controlling the action of this motive power.

The type-wheel employed has four rows of characters and is combined with means for raising or lowering it for the proper alignment of any one of the rows. An oscillating movement is also given to the type-wheel whereby any desired character is printed on the paper. Mechanism is provided for rotating the type-wheel to present any desired character of a given row to the paper in the printing position; also for moving the type-wheel and its carriage laterally across the face of the paper and for its return to the starting or initial point, also for feeding the paper upward at the end of each printed line.

Mechanisms, all actuated by the above mentioned motor, also set the type-wheel, make the printed impression, control the letter feed and spacing, return the type-wheel carriage and feed the paper. The first, second, third and fourth positions of the type-wheel, presenting the various rows of characters to be printed, are obtained by the action of the motor, as well as the restoration of the wheel from the fourth to its original or first position.

The setting mechanism which governs all of the above movements is a small light shaft actuated frictionally by the motor and released, step by step, by a sensitive polarized relay in the main line circuit. Here inertia is small, and a consequent high speed of revolution obtained—400 or more revolutions per minute.

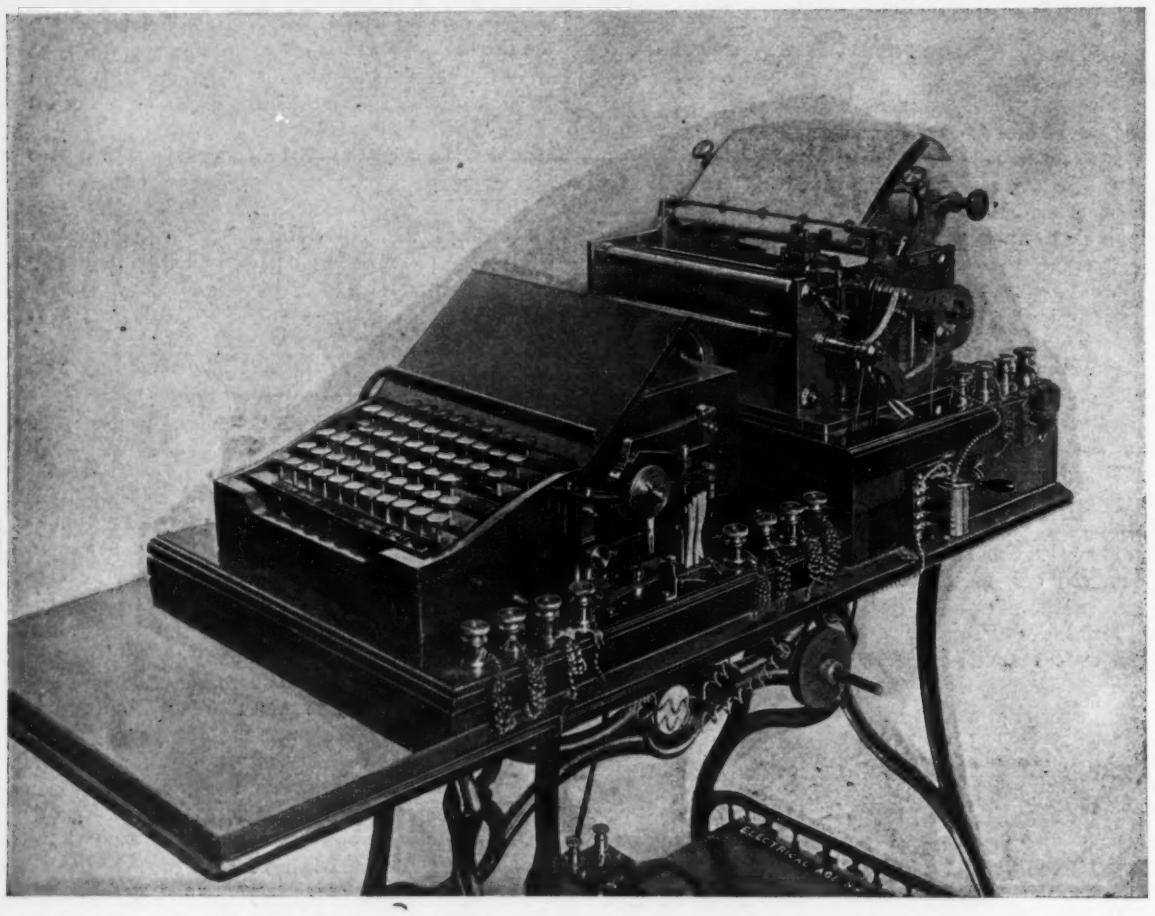
On this shaft are an escapement wheel, ratchet retaining wheel, unison device and a setting pin and wedge. The moment the pin is placed in the proper position by the action of rapidly reversed currents, other magnets in the circuit, neutral and less sensitive, are affected by the prolongation of the current and release the mechanisms connected with the motor, necessary to perform the various functions already enumerated.

The work done by these magnets which are in the main line circuit (there are three of them) is of the highest character possible, and the working of the instrument over long circuits, where light currents are necessarily employed, is practically assured. In practice a speed of over 40 words per minute on a 200-mile circuit, using the ordinary Morse power, has been reached, and will probably be exceeded when operators shall have become entirely familiar with the working of the machine.

Typewriting by wire and by ordinary typewriting methods have been the objects sought to be obtained in the American type telegraph. The width of the paper, the form and action of the keyboard, as well as the manipulation of the machine generally, are made to conform, as nearly as possible, to the practice with which an ordinary typewriting operator is familiar. But all these qualities, were they not accompanied by the prime adjunct of a good commercial speed, would be insufficient. A new device, to be commercially successful, must maintain or increase the carrying capacity of a wire. And this it is claimed is done by the American type telegraph.

The accompanying cut illustrates the machine which has been referred to above. The company is, however, manufacturing another and smaller machine, which also works at a good speed and delivers its matter in the same form, for private line working. In this latter device the motor is eliminated and the construction is generally simpler.

A column, or page-printing machine by the same inventor, has been working successfully in London for the past three years, delivering news reports to all the leading newspapers and clubs. The instruments owned by The American Type Telegraph Company, of 670 Hudson street, New York City, comprise the London machine as well as the two others referred to above. The success of the London machine may be taken as some indication of the capacity of the two latest machines, which have not only been improved in every detail, but in principle also; the speed of the motor machine being more than double that of the English one. The inventor of these instruments, including the London one, is Mr. J. E. Wright, of New York, who has had a wide experience in the transmission of news and other telegraphic matter.



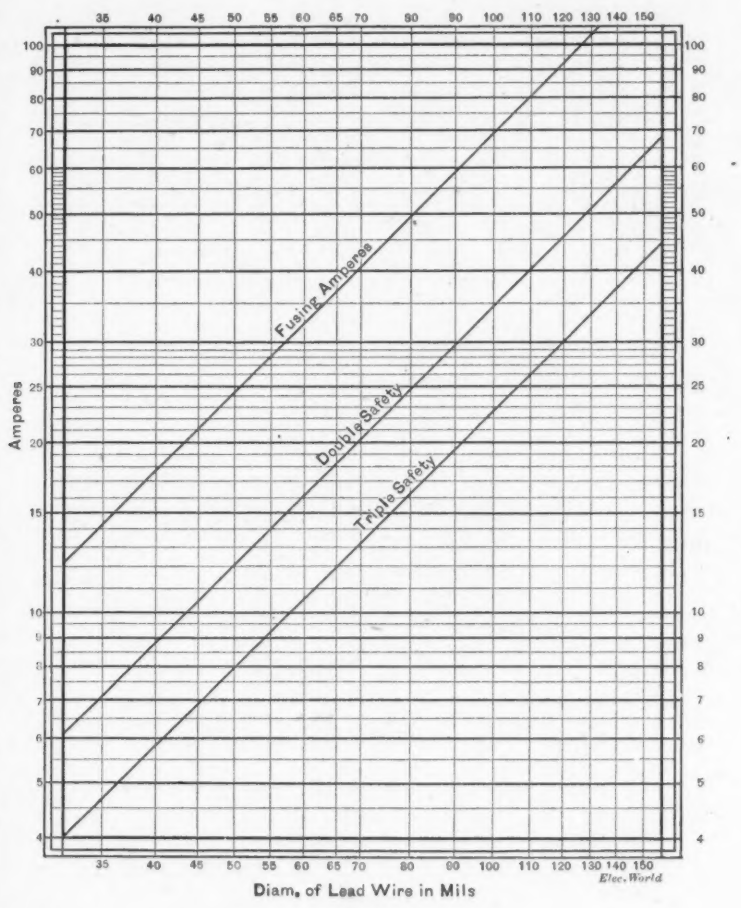
THE AMERICAN TYPE TELEGRAPH.

Diagram for Calculating Fuse Wires.

In our issue of March 26, p. 213, we published a very convenient diagram devised by Mr. Josef Herzog, of Budapest, for finding the horse power corresponding to any number of volts and ampères, without any calculation or cumbersome tables. The ingenious device for reducing all the lines in this diagram from curves to straight lines was to use logarithmic scales instead of the usual arithmetical ones, but the person using this diagram need know nothing about logarithms, or even about arithmetic. It reduces the amount of work in such computations to even less than it takes to look up the results in a table.

The same principle which was used in that diagram is also applied by Mr. Herzog to the accompanying one, which is for finding, without calculation, what size to make a fuse wire for a given current, or at what current a given fuse will blow.

The diagram is so simple that an explanation is hardly required. For a given current, say 20 ampères, follow the horizontal line corresponding to 20 to its intersection with the diagonal, and from the point of intersection follow the vertical lines to the upper or lower scale where the corresponding diameter in mils will be found. For the reverse calculation this process is merely reversed, starting at the horizontal scale, and ending at the vertical. There are three diagonals given, one for the fusing current and the other two for factors of safety of two and three, as usually used in wiring, a fuse being generally taken for double or triple the normal current. It should be noticed that the scales are out of regular intervals.



FUSE WIRE DIAGRAM.

It is well known that the fusing current of a lead wire is dependent not only on the diameter of the wire but also on the length, the nature of the terminals and other conditions, such for instance as the use of an alloy instead of lead; any determinations of this sort giving the fusing current are, therefore, dependent on the particular style of fuses to be used.

The formula for the fuse for which this diagram was calculated is

$$C = 17\, d^{\frac{3}{2}}$$

in which C is the fusing current in ampères and d is the diameter in millimetres. Reducing this to our units in which the diameter D is in mils, gives

$$C = .069\, D^{\frac{3}{2}}.$$

The difference in fuses of various makes merely changes the constants in this formula, which in turn changes only the position of the diagonal lines in the diagram, without changing its angle. This method of graphical calculations therefore has the advantage that for any other constants all that is necessary is to draw a new diagonal parallel to the others, to suit the particular style of fuse which one is using. By making a test of a few sample fuses and plotting the results on the diagram, then drawing a diagonal through the points, the diagram will be ready to be used for that style of fuse.

Test of the Neversink Mountain Electric Road.—IX.*

BY HERMANN S. HERING AND WILLIAM S. ALDRICH,
OF JOHNS HOPKINS UNIVERSITY.

VII.—SPECIAL CAR TEST.—(*Continued.*)

Plotted Results of the Special Car Test.—During this test of Neversink Car No. 4, made by the authors Aug. 17–18, 1891, for THE ELECTRICAL WORLD, there were simultaneous observations taken throughout at the station and on the car, to determine the complete distribution of power, from the hydraulic horse power at the station to the power available at the car axle, while only one car was run over the road. These observations, corrected for calibrations, and the results and computations therefrom, have been plotted on a time base in Fig. 24 for the usual round trip. The individual turbine and hydraulic horse power have been obtained from the observed turbine shaft speeds and gate-openings in exactly the same way as in the test of the power plant, already explained in the preceding articles of this test (THE ELECTRICAL WORLD June 18 and 25, 1892). The turbine friction horse power is the difference between the hydraulic and turbine powers, and the efficiency is the quotient of the same on corresponding time ordinates. The total turbine, hydraulic and friction horse powers representing the performance of the coupled turbines have been plotted as the sum of the simultaneous individual values, while the efficiency of the coupled turbines at any moment is the quotient of the simultaneous total turbine and total hydraulic horse powers. The curves of the two latter have been plotted directly over the electrical horse powers at the station, and under this, the electrical horse power delivered to the car. These electrical horse power curves have been plotted from the corresponding values of the station and car volts and amperes, on the same ordinates.

Below these curves showing the variations of power at the station and on the car, the mean car speeds between turnouts and other observed points along the route have been plotted on the time base, which mean speeds were formerly plotted on the distance base of the car-route profile of Fig. 22, (THE ELECTRICAL WORLD, July 9, 1892). The turnouts and switches have been diagrammatically plotted below this, being located by the time interval of the watch-time observations.

As the performance of cars on grades is so important in electric traction work, the rate of lift of this car on all the up grades has been plotted in the curve at the foot of this diagram. This rate of car-lift as well as car-drop is expressed in feet per minute for the time interval of the mean speed (assumed uniform) between turnouts and other observed points as plotted above. The vertical scale is in feet, representing the elevation of the car at any time along the route above the Reading City datum,—the zero of the scale; the horizontal scale is, of course, the time base, and represents the time at which the car reached any given elevation. The horizontal distance between any two points on the curve, therefore, represents the time during which the car was raised (or lowered) a distance equal to the difference in elevation of these points. Thus, in ascending the 4 per cent. grade to Point Lookout (Summit), the distance on the time base is 1 minute and 40 seconds (given in table below at foot of diagram); the car ascended from an altitude of 546.5 feet to one of 605.5 feet, being therefore lifted 59 feet in 1 minute and 40 seconds, a rate of car lift of 35.4 feet per minute; the surveyed grade length of 1,475 feet gives a mean speed of 888 feet per minute, or 10.1 miles per hour, on this grade. The elevations, grades and grade lengths for this curve and the table below, have been taken from the road data given in THE ELECTRICAL WORLD, June 11, 1892.

On comparing this car-lift curve of Fig. 24 with the car-route profile of Fig. 22, it will be obvious that any point, as the Upper Junction, is at the same elevation on both curves; but on the time-base plot the car is represented as being at this point at a certain time, while on the distance-base plot it is evidently shown to be a certain distance from Klapperthal Terminal. Another obvious distinction between the two curves just referred to is that the time-base curve represents the difference of level in the car position per minute, while the distance-base curve shows it per 100 feet.

The dotted ordinates of the car-lift curve, Fig 24, are at the points where the grades change, and the table below is lined up with these. By adding the time intervals on all up grades, the total is 29 minutes and 50 seconds, while the corresponding total lengths of these up grades is 27,028 feet, and the sum of the differences of level (the total car-lift) is 1,014 feet. These values give a mean speed of 906 feet per minute, or 10.3 miles per hour and a car-lift rate of 34 feet per minute. The sum of the differences of level, of 1,014 feet, is the total car-lift for the round trip as made by this car in its run from the Klapperthal car-house and return; and the sum of the grade lengths being 27,028 feet. gives a mean rise of 3.75 feet per 100, which may be looked upon as the mean up-grade for the particular route of this test. The above value of 34 feet is the height the car is lifted in one minute, while the value 3.75 feet is that through which it is lifted per hundred feet.

The difference between the volts at the station and the volts at the car is evidently due to the line resistance, the drop on the up grades being caused by the current used by

*For the first eight sections of this article see THE ELECTRICAL WORLD of May 28, June 4, 11, 18, 25, July 2, 9 and 16, 1892.

TIME HRS. & MIN.
11.30 P.M. 35 40 45 50 55 12.00 5 10 15 20 25 30 35 A.M.
Coupled Turbines
Efficiency
Total Turbine Friction H.P.
No. 2. Turbine FIXED GATE OPENING OF 17.4%
Efficiency
Turbine Friction H.P.
Hydraulic Horse Power
Turbine Horse Power
No. 1. Turbine
Efficiency
Turbine Friction H.P.
Hydraulic Horse Power
Turbine Horse Power
Gate Opening in per cent.
Turbine Shaft Revolutions per minute
Variations of Power, from Hydraulic H.P. at Station to Electrical H.P. delivered to Car.
Hydraulic Horse Power
Turbine Horse Power
E.H.P. at Car
E.H.P. at Station
Volts at Car
Volts at Station
Amperes Station & Car
Mean Speed of Car between Turnouts and other Observed points Miles per hour.
Turnouts and Switches
14 13 Tr. 12 11 4 3 2 1 1 2 3 4 5 6 7 8 9 10 11 12 Tr. 13 14
Car Lift and Car Drop in feet, for Time interval of Mean Speed between Observed points
Stopped 1 m. 15 s.
Started and Stopped
Stopped 2 m. 35 s.
Stopped 2 m. 30 s.
Stopped 15 s.
TIME HRS. & MIN.
11.30 P.M. 35 40 45 50 55 12.00 5 10 15 20 25 30 35 A.M.
Time between Observed points
Grade, per cent
Length of Grade in feet
Mean Speed on Grade Miles per H.
3.64
4.0
3.94
3.64
7805
4200
9350
11975
11.43
11.2
10.62
11.95
Car-Route Stations.
Klapperthal Car House
Trestle and Park Station
Upper Junction
Lower Junction
White House Level
Mahlenburg St. Crossing
Ninth & Penn St. Bay Terminal
Mahlenburg St. Crossing
White House Level
Lower Junction
Goat's Gap
Neversink Mt. Hotel
Station
Point Lookout
Highland House
Upper Junction
Trestle and Park Station
Klapperthal Car House

Elec. World

FIG. 24.—STATION, CAR AND ROUTE DATA OF SPECIAL CAR TEST AUG. 17 AND 18, 1891.

Test of Neversink Car No. 3 equipped with two No. 12 Edison S. R. 25 h. p. motors; Style, B.; Weight of car and load, 22,500 pounds. Plotted on time-base for entire car route.

the motors and the lamps on the car, and that on the down grades by the lamps only. An examination of the electrical horse power curves at the station and at the car as obtained from the curves of volts and ampères, will show, in connection with them, many interesting points and characteristic variations. Thus: On arriving at the White House level, at 12–3–30, having come up the steepest grade on the road (6.4 per cent.), the current of 95 ampères was suddenly thrown off, producing a rapid increase of the volts at the station from 510 to 590, caused by the very rapid increase of the speed of the turbines from 108 to 122 revolutions. Just at this point it is well to note the peculiar variations in all the curves on the same time ordinate,—variation which are more or less characteristic of the station performance under extreme and sudden variations of load, which have been fully explained in connection with similar features in the test of the power plant.

Performance of the Turbines During the Special Car Test.—The peculiar conditions under which the turbines were operated at this time gave rise to a performance as coupled turbines, which deserves more than passing notice. When operating the road with only one car or light loads, it is usual to run one turbine at a fixed gate-opening while the gate of the other is controlled by the governor. During the run of this special car over the road the customary methods of operating were followed; the gate of No. 2 turbine was set at 17.4 per cent. of its full opening, which is the usual opening of two turns of the hand wheel connected with the speed gate gearing; and only one dynamo was used, the other being unclutched. The four curves of No. 2, turbine by their extremely small variations, show the very steady conditions prevailing in its operation under fixed gate, those which occur being due to the speed changes. Practically all the changes in the external load and the irregular variations of the station momentum, have to be met by the No. 1 turbine, whose gate is entirely controlled by the speed changes, through its centrifugal governor At first sight it will be noticed how characteristic are all the simultaneous variations in the performance of the No. 1 turbine compared with those of the coupled turbines; for this would be naturally expected if No. 1 were used alone, and is clearly seen to be also the case when it is operated in connection with a fixed load on the other turbine.

Governing No. 1 turbine under these conditions is shown to be irregular, by the variations in its gate and power curves as related to the changes of speed of the turbine shaft. In some instances its gate was adjusted about right the first time that a change occurred; at other times, the gate was opened or closed by successive steps before the turbine settled down to steady running conditions, when such were made possible by the character of the load. Thus, at 11–40 the variations throughout the entire plant enabled No. 1 turbine to so change its gate as to give nearly the output required under no load on the dynamos; but this was evidently too low as is shown by the turbine output slightly increasing at 11–41.

At 11-45-30, when the car was just starting from the White House, when the throw of current of 90 ampères produced very marked variations throughout; first lowering the speed as the station momentum was drawn upon, then after a few seconds, when this current was thrown off, rapidly increasing the speed beyond that required for steady conditions under no load. In this case No. 1 turbine settled down to somewhat steady running at 11:50, after a series of speed and gate changes. The remarkable features, as to the length of time required for the turbine to thus settle down after heavy loads were thrown off the dynamos, is also clearly shown at about 11–55 and 12–25.

Anomalous conditions frequently arise when one of the turbines is operated at a fixed gate. Its constant output being sometimes more and sometimes less than that required to meet the dynamo load, has such an effect upon the momentum of the station machinery, and the consequent changes in speed and position of No. 1 gate, as to bring about the following conditions: (a) No. 1 gate opening and turbine speed simultaneously increasing; (b) No. 1 gate opening and turbine speed simultaneously decreasing.

The conditions giving rise to the first usually occur on throwing the current off or on for a few seconds only, when passing turnouts or a junction, but not stopping the car. This results, on the one hand, in no external load between two more or less heavy loads, as in passing No. 4 turnout, 25 to 35 seconds after 12–6. Again, on the other hand, when a heavy current is thrown on for a few seconds only in starting up from no external load the conditions of (a) are also realized, as at 11–45–45, when there was a throw of 90 ampères for a few seconds when starting from the White House. At another time similar variations were caused, as by throwing off the current for a few seconds in passing No. 1 turnout; but in this, as in the other cases already cited, the lagging behind of the turbine variations is to be carefully noted, and here occurs in a peculiar manner from 11–52–38 to 53–10. The condition under (a) is here clearly shown by the turbine horse power decreasing the same time that the hydraulic horse power increases, which also occurred in passing No. 6 turnout, 12-12-30 to 50 seconds.

The conditions under (b) almost always prevail after loads have been thrown off the dynamo and while the turbines are making an effort to settle down to steady running, with no external load on the dynamo. Thus, after passing the Upper Junction and while the car was going down grade the turbine speed and the No. 1 gate were both decreasing; similarly at 11–46–45 to 11–47–0 and at 12–24–18 to 12–25–0. In the latter, the turbine horse power increases while the hydraulic decreases, which is the usual result of the speed and gate conditions noted under this case. At 11–54 to 11–55 the turbine horse power rapidly increases with simultaneous decrease of the hydraulic horse power, while No. 1 gate is closing and the turbine speed rapidly decreases, then for a moment slowly increases during the continued closing of the gate.

Upon first examination of the combined electrical and turbine power curves it is apparent that the variations of the latter always lag behind the instantaneous variations of the former. This time lag between variations, which would otherwise be simultaneous in the power curves, is due to the station momentum being drawn upon or added to as the case may be, according to whether the dynamo load has suddenly decreased or increased. The momentum of the station machinery plays so important a part in turbine power plants for electric traction, on account of the incompressible nature of the water as a working fluid in the prime movers; this, in connection with the sluggish action of centrifugal governing, makes it impossible for the dynamo and turbine changes to be simultaneous. This matter has been fully explained in preceding articles about the station test. The difficulties of turbine governing are well known, but with regard to this matter it has simply been the object throughout these articles to show how the turbines behaved as installed and operated under these conditions.

Tabulated Values of the Special Car Test Plot.—Table XVII. contains observed and mean values taken from the plot in Fig. 24. The plotted curves for the two principal and longest grades, 3.64 per cent. and 3.94 per cent., have been integrated for their time interval, and the means arranged, as shown in the table, to correspond with their location in the plot—an arrangement which facilitates reference and has been adhered to throughout in this tabulation. It was on these long grades that the most steady conditions were obtainable throughout the entire run. It is therefore of special interest to be able to read off values throughout the entire system on a suitable time ordinate in this interval of steady running. This has been done for the 3.64 per cent. grade on the 11–37–30 ordinate, and for the 3.94 per cent. grade on the 12–8–0 ordinate. After the car passed the Highland House, the remainder of the trip was made entirely down grade to the Klapperthal car house. At about 12–28 the whole station had settled down to steady running and continued so until the end of the observations. Readings have been taken throughout the entire plot on the 12–30 ordinate, and these tabulated values show very well the distribution of power and the efficiencies when the plant was running regularly and no current supplied to the car motors.

The maximum and minimum values have also been tabulated for the several curves, and the integrated means have been obtained for all the continuous curves (except those of efficiency), and these three sets of values for the entire car route arranged in the table.

Table xvii.

Observed and mean values taken from Fig. 24. Values on the two principal grades, and maximum, minimum and mean values for entire trip of the special test car No. 4.

Grade on which reading was taken.	3.64%.		3.94%.		3.64% down.	Entire car route.		
Time and time interval on grade.	11-37-30	11-31-45 to 11-39-30	12-8-0.	12-6-0 to 12-16-0.	12-30.	11-30 to 12-35.		
Conditions.	Steady.	Mean.	Steady.	Mean.	No Load.	Max.	Min.	Mean.
Coupled Turbines								
Efficiency	49.1	47.4	48.5	46.7	22.3	49.5	–4.88‡	34.4*
Total turbine friction H. P.	96.8	98.3	96.3	98.2	97.1	111.5	93.8	98.87
No. 2 Turbine.								
Efficiency	33.8	32.9	34.0	31.4	30.8	34.2	14.5	31.3*
Turbine friction H. P.	48.7	48.73	48.7	49.72	50.1	59.1	48.6	50.1
Hydraulic H. P.	73.5	73.5	73.7	72.5	72.4	73.8	69.1	72 2
Turbine H. P.	24.8	24.18	25.0	22.75	22.3	25.2	10.0	22.6
No. 1 Turbine.								
Efficiency	58.7	57.4	58.0	55.8	10.5	60.2	–40.9‡	38.0*
Turbine friction H. P.	48.1	49.93	48.1	49.38	47.5	56.2	43.9	48.61
Hydraulic H. P.	116.5	114.2	114.5	110.0	52.5	123.1	37.2	78 2
Turbine H. P.	68.4	65.6	66.4	61.5	5.5	74.2	–15.2‡	29.7
Gate opening, per cent.	31.7	30.6	31.0	30.2	12.0	34.8	8.7	20.25
Turbine shaft revolutions per minute	97.0	98.5	97.0	101.5	103.0	122.0	96.0	103.5
Variations of power from hydraulic H. P. at station to electrical H. P. delivered to car.								
Hydraulic H. P.	190.0	187.0	188.2	184.2	124.9	195.	116.3	150.5
Turbine H. P.	93.2	88.7	91.4	86.0	27.8	95.6	4.88	51.75
E. H. P. at station	48.5	45.9	47.6	44.7	0.	63.9	0.	... ..
E. H. P. at car	46.0	43.1	44.8	42 3	0.	59.4	0.	.....
Volts at station	517.	510.	509.	500.	501.	590.	450.	509.6
Volts at car	490.	487.	476.	485.	500.	589.	410.	494.7
Ampères	70.	67.1	70.	66.9	0.	95.	0.	.....
Mean car speed, miles per hour	12.4	11.43	11.4	10.62	12.0	21.2	0.	11.05†

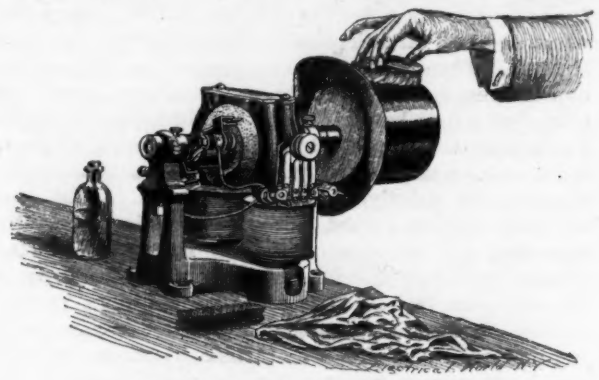
* Calculated from integrated means of H. P. curves for entire run. All other values in this column are integrated means, except mean car speed.

† Value taken from Table No. XII.

‡ The negative values for the turbine horse powers arise from that particular turbine being driven by the other under sudden changes of load. The negative values of the efficiencies are due to negative horse powers.

Electric Hat Polisher.

The electric hat polisher is the latest innovation in the field of applied electricity. In the lower corridor of the Produce Exchange building may be seen in daily use a practical illustration of this process. The operation, which the accompanying illustrations plainly show, is as simple as it is effective. The hat is slipped over a clutch which holds it firmly, and the clutch is attached to the end of the shaft of a small Crocker-Wheeler motor. The current is



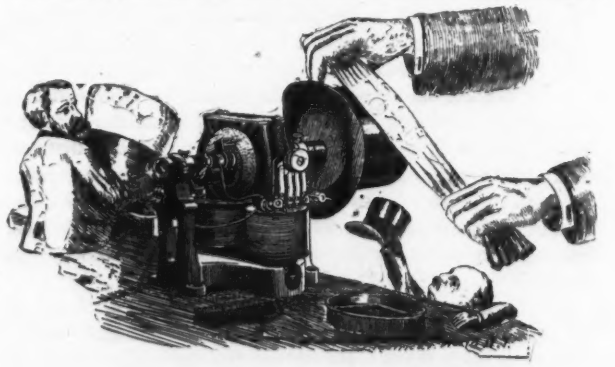
An Electric Hat Polisher.

switched on, and as the hat spins around at the rate of 2,000 revolutions a minute, a brush moistened with benzine, or some more mysterious fluid, is applied. After this cleansing, strips of silk or plush take the place of the brush, and the hat is polished off. Ironing is rendered unnecessary, as the heat developed by the friction against the rapidly moving surface answers every purpose of a heated iron. Not only is much time saved over the old method, but the results are said to be superior. Silk derby or straw hats are renovated with equal success.

Tested Fuse Wire.

Any person familiar with the fuse wire market cannot have failed to notice the very material difference in length of fuses recommended by different makers or directly sanctioned by them in the manufacture of links and of fuse boxes and branch blocks which limit the length of the fuse. For instance 100-ampère links may be found on the market varying from one to eight inches in length, and there is a corresponding disparity in other sizes, while boxes which will accommodate fuses of widely different lengths are very common. If the fuse is of sufficient length, fusing is caused by its inability to conduct away the heat which is generated in it, as is demonstrated by the well known fact that a long fuse gives way in the middle, showing that the heat is generated faster than it can be disposed of by conduction. A short fuse, on the contrary, is fused because of the inability of the terminals to dispose of the heat, which fact accounts for the complete destruction of the fuse in so large a proportion of cases.

The critical difference between the two is that the fusing point of a long fuse is dependent upon itself while that of a short fuse is dependent upon the terminals and varies with their size and weight. That fuse wire or fuse strips can be made perfectly reliable as to carrying capacity and fusing point is a demonstrated fact, as shown by tests recently made at Cornell University and at the Sperry Electric Mining Machine Company's factory at Chicago. It is apparent that to be reliable a fuse must be self-contained and entirely independent of the terminals to which it may be attached. With short fuses, moreover, there is a tendency to arc across the terminals, the consequences of which may be very serious. To show the actual variation in fusing point for different lengths the following examples



An Electric Hat Polisher.

are given: Wire rated as 5-ampère safe carrying capacity in 1¼-inch length fuses at 10 ampères, while in ½-inch length at 19 ampères; rated at 10 ampères in 2¼-inch length fuses at 18 ampères, in ¾-inch length at 29½-ampères; rated at 50 ampères in 3-inch length fuses at 72½, in 1-inch length at 110 ampères; rated at 200 ampères in 4¼-inch length fuses at 244 ampères, in 1-inch length at 316 ampères.

It will be seen from the above that in the small sizes a larger percentage of allowance is made between safe carrying and fusing points, as the danger element is small and the unnecessary blowing of a fuse bothersome. As the capacity increases the percentage is lowered, until at 500 ampères but 10 per cent. of allowance is made. It must be understood, however, that the results in case of the short fuses are dependent in a large measure on the terminals, and this element of uncertainty is inevitable whenever such fuses are used, since it is impossible for the manufacturer to anticipate what size terminals will be used by the station superintendent.

Tests of Two 6,500-Watt Westinghouse Transformers—II.*

BY DR. JOHN HOPKINSON.

If the transformers had been exactly equal, the potentials for the two given by Table I. would have been equal, though they would have differed a little in phase owing to the lines of magnetic induction which pass through the non-magnetic space between the two coils of the transformer.† The difference shows that No. 1 transformer has a ratio of transformation slightly greater than No. 2. If we correct the potential of either No. 1 or No. 2, there still remains a difference between them, but this difference will be greatest about when the potentials are *nil*. This is due to the lost induction just referred to. In order to check the conclusion that the two transformers are not precisely equal, they were directly compared as in Fig. 8. The transformers were coupled parallel, as in Fig. 8, and the difference of potential of the two high potential coils was measured, the value of its square root of mean square was

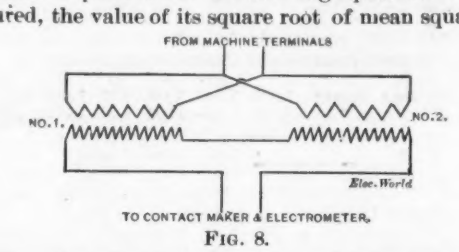
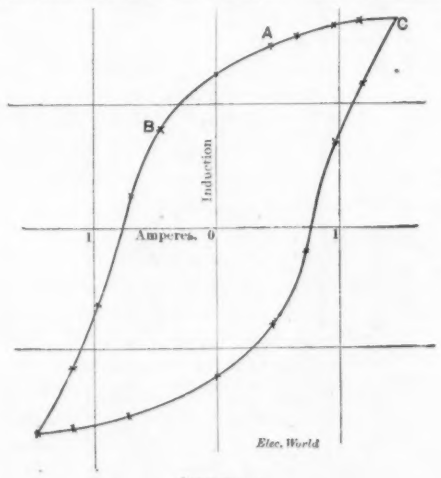


FIG. 8.

12.5 volts, the potential of the transformer being 2,400. This does not necessarily imply that the potentials of the two transformers differ by one-half per cent.; it may be largely due to a difference of phase between the two.

The current supplied to the No. 1 transformer is to be accounted for by the currents necessary to magnetize the two transformers and by the local currents in their cores. To ascertain the former, the curve of magnetization of one of the transformers was determined by the ballistic galvanometer for nearly the same induction as in Table I. The changes of current supplied by a battery being made by a reversing switch, or by suddenly introducing resistance into the primary circuit, and the consequent changes of induction being measured by the galvanometer. The tardiness of change of current in the transformer due to its self-induction was sufficiently reduced by using many cells and a considerable resistance. The results are shown in curve V. for a single transformer. In this curve the abscissæ are the currents in the thin coil of the transformer, divided by 24, to reduce it to the same effect as it would have had if it had been in the thick coil. The ordinates are the inductions as measured by the kick on the galvanometer, but reduced to a scale to make them directly comparable with the volts when the transformer is used with an alternating current. These results are not given in absolute units. The procedure to determine points on the curve was, first, pass the maximum current corresponding to the point *C*, next suddenly diminish the current by inserting suitable resistance in the thin coil circuit, and observe the kick, the drop of ordinate from *C* to *A* corresponds to the kick; and the abscissa of *A* is the current after it has been reduced. Next reverse the current, and observe the kick; the kick corresponds to the further drop of ordinates from *A* to *B*. In this manner a series of points are determined on the curve. Curve VI. shows the relation between induction and magnetizing current for the pair of transformers as deduced from the experiments with alternating currents set forth in Table I. The ordinates in this

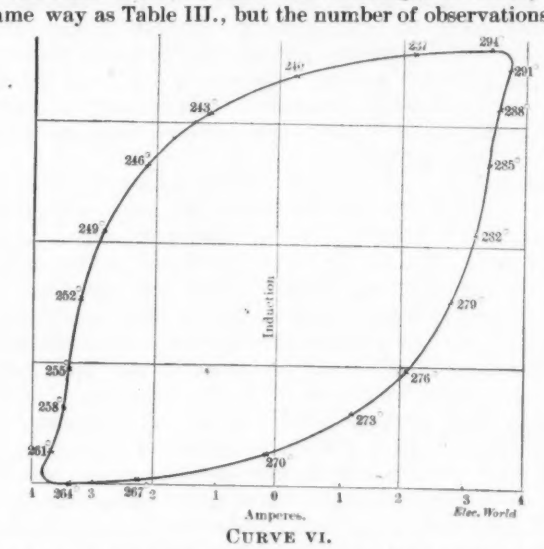


CURVE V.

curve are the area of the curve of potentials of curve I., for the ordinates of this latter curve are the rates at which the induction is changing, while the abscissæ are the currents in the thick wire at corresponding times. The points marked • in curve VII. give the remainder after deducting the magnetizing current as estimates in curve V., from the currents of curve VI., that is to say, curve V. is corrected first for the small difference in maximum induction; then corresponding to any induction the current is taken from the curve, it is doubled as there is only one transformer, and the result is deduced from the corresponding current of curve VI. The differences are, the magnetizing current equivalent and opposite in effect to the local currents in the cores. If the local currents were equivalent to a current in a single secondary circuit, the points • of curve VII. ought to have had the form of the full line of curve VII. drawn through the points +, in which the abscissæ are proportional to the potential difference, and the ordinates to the induction. Returning to Table I., we find that the fall of potential difference on open circuit in the whole combination is 0.8 volt, and that the loss of power in magnetizing the cores and in local currents is 222.86 watts, that is, a loss for each transformer of 114.13 watts. The total loss of 228 watts may be divided into 126 watts accounted for by hysteresis, and 102 watts due to local currents.

Referring now to Table III. and curve III. the earlier columns explain themselves, but a word is necessary about the last six columns. The watts supplied to No. 1 are simply the products at each time of the volts at its terminals, and the ampères, passing through, similarly to the watts given out by No. 2. We see firstly that the efficiency of the whole combination with this load is 93.73 per cent., and hence the efficiency of one transformer, if the losses in the two are equal, may be taken as 96.9 per cent. The fall of potential in the whole combination is 6.1 volts; but the fall with no load is 0.8 volt, hence the variation due to the load with constant potential on the thin coil of No. 1 is 5.3 volts, or if the fall of potential in the two transformers were equal, which it is not, for a single transformer, 2.65 volts. Assuming that the transformers are equal, the power lost in resistance would be expected to be the mean of mean current × the difference of potential difference or 215.4 watts. It is, in fact, 150 watts, as given by multiplying the square of currents by resistances. But the transformers are not exactly equal, and there is the waste magnetic field, both of which will have a small effect on the distribution of loss between the two classes of loss, viz., that by hysteresis and local currents, and that by resistance, but none upon the gross efficiency.

The other tables, II. and IV., are arranged in exactly the same way as Table III., but the number of observations on



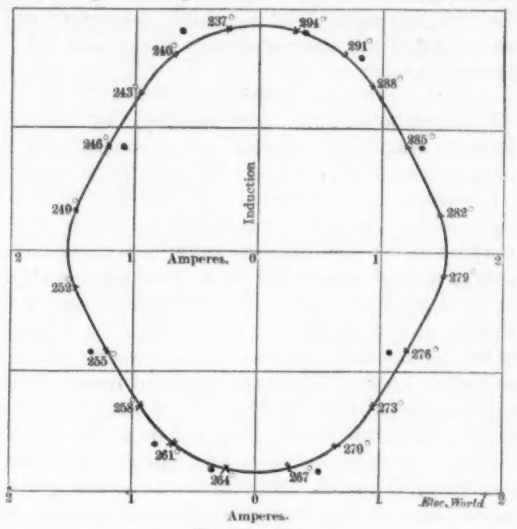
CURVE VI.

Table IV. is insufficient to bring out all the peculiarities of the transformers.

It has already been stated that, if the loss of potential due to load in the two transformers be equal, it will amount to 2.65 per cent. The following experiment was tried to ascertain if this loss was equal: The transformers were coupled in series as before. The mean potential difference of the thick wire was measured by Thomson's multicellular, and of the thin wire by Thomson's electrostatic voltmeter. The mean of a considerable number of experiments is given in the following table, the load being the same as in Table III., and the results being corrected to the same potential of the thin wire:—

Number.	Full load.		Open circuit.	
	Thomson's multicellular.	Thomson's electrostatic.	Thomson's multicellular.	Thomson's electrostatic.
1	2,380	99.8	2,380	97.0
2	2,380	94.2	2,380	96.2

This shows that of a total drop of 4.8 volts, 2.8 volts occurred in No. 1, and 2 volts in No. 2. There is no doubt of the fact that the drop is greater in No. 1 than in No. 2, which is connected with the waste field between the two coils. Of course these transformers are intended to work exactly as No. 2 is working, in which case the drop from no load to nearly full load, as shown by this experiment, is 2.0 volts. The way in which this waste field causes inequality of drop of potential in the two transformers, coupled as in my experiments, is well worthy of careful consideration. The waste field is proportional to the current in the transformers, or, better, to the mean of the two currents in ampère turns. The electromotive force due to this waste field will be proportional to the rate of change of the current. If the current were expressed by a simple harmonic curve, the electromotive force due to the waste field would also be a simple harmonic curve differing in phase by $\frac{N}{2}$. The curve of potentials is roughly in the same phase as the curve of current. Let *A* be the amplitude of potential difference of No. 2 transformer, *B* be the amplitude of difference of potential difference in No. 2, or the potential difference of the thin wire divided by 24. 2 *b* will be very nearly the amplitude of difference between the thick wires of Nos. 1 and 2. The ratios of potentials in No. 1 and No. 2 will then be $\frac{\sqrt{a^2 + -4b^2}}{\sqrt{a^2 + b^2}}$ and $\frac{\sqrt{a^2 + b^2}}{a}$, or $1 + \frac{3}{2}\frac{b^2}{a^2}$ and $1 + \frac{b^2}{2a^2}$ or the drop in the first from this cause is three times as great as in the second transformer. We shall return to the waste field immediately. Putting aside harmonic curves, and returning to the facts as they are, the following Table V. gives first, half the difference of potential difference taken from Table III. that is at each instant the drop of potential in No. 2; secondly, the volts of the thin wire of No. 2 reduced for number of convolutions; this is of course the means of potential difference between 1 and 2; lastly, the squares of these volts. From this we see a mean square 100.8 showing the drop in No. 2 to be 2.6 volts, out of a



CURVE VII.

total drop of 6.1, and the remainder 2.5, the drop in No. 1. Diminishing these results by 0.4, the half of 0.8, the fall observed with no load, the actual losses from no load to nearly full load will be 2.2 and 3.1.

TABLE V.

Half difference of potential difference.	Volts of high potential coil divided by 24.	Squares of volts.
15.6	−5.0	25.0
14.8	41.3	1,706.0
11.3	74.3	5,520.0
10.8	102.6	10,530.0
11.1	131.3	17,240.0
5.5	147.1	21,640.0
−1.1	137.0	18,770 0
−3.1	119.3	14,230.0
−5.9	95.1	9,040.0
−12.1	53.4	2,850.0

Square root of mean square = 100.8.

Turn now to the last column of Table III. This gives the difference of potential differences corrected for the loss of volts by resistance. It is shown on dotted Curve III.; this curve presents one or two peculiar features. It should be possible to infer the form of this curve from the curve of current. The rates at which the mean current is changing are as follows:

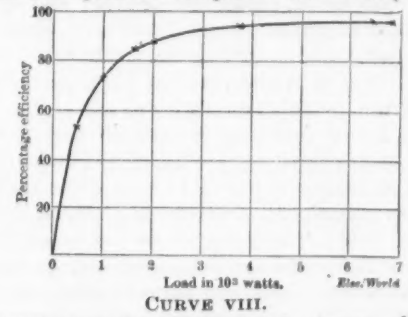
268½	271½	274½	277½	280½	283½	286½	289½	292½	....
30.7	24.2	19.2	18.5	13.9	1.7	−9.3	−12.7	−21.7	−28.1

which happens to come to a scale which can be at once plotted. The points marked • are the points of the curve corresponding with the above rates. The agreement of the points with the curve is remarkably close. This exhibits very completely the effect of waste magnetic field.

For half power, as taken from Table II., the rates are:

268½	271½	274½	277½	280½	283½	286½	289½	292½	295½
14.6	11.5	9 4	10.6	4.4	−4.6	−7.2	−7.5	−13.6	−17.6

and in the same way in Curve II. the dotted curve represents the difference of electromotive force corrected for resistance, and the points correspond with the above rates.



CURVE VIII.

Curve VIII. gives the efficiencies in terms of the load. This curve is the hyperbole:

$$\text{Efficiency} = 100.\ \frac{X - (A + B\,X\,C\,X^2)}{X}$$

Where $A = 228$, the loss by hysteresis.

$B = 0.005$, and mainly depends upon the waste field.

$C = 0.0000035$, and is mainly the loss by resistance.

X = Load in watts.

To sum up, I find that the efficiency of the transformer at full load would be 96.9 per cent.; at half load, 96 per cent., and at quarter load, 84.7 per cent. The magnetizing current of the transformer amounts to 114 watts, or 1.75 per cent. The drop of potential from no load to full load is between 2 per cent. and 2.2 per cent.

In conclusion, I wish to express my thanks to Mr. Wilson, of King's College; this gentleman carried out the experiments under my direction, and made nearly all the numerical calulations and drew most of the curves for me.

* A report made to the Westinghouse Electric & Manufacturing Company, reprinted from *The Electrician*, London. For the first section of the report see THE ELECTRICAL WORLD of July 16, 1892.

† Prof. Perry has already pointed out that the effect of such an induction cannot be entirely neglected, even in endless circuit transformers.

Multiphase Transmission and Distribution of Electric Energy.—III.*

BY A. RECKENZAUN.

Prof. Thomson, in a recent communication, dwells upon the great importance of the multiphase system for power transmission. Although an advocate and manufacturer of alternating current machines, he is of the opinion that the ordinary alternator is unsuitable for power transmission. "It is essentially non-starting. Too much complication is introduced into the plant by the introduction of elaborate devices for starting."

Referring to the Frankfort-Lauffen plant, Prof. Thomson said that "this experiment was quite successful, so far as an exemplification of a commercial transmission. It served its purpose in proving the possibility of working with alternating currents of very high potentials, and also showed in a striking manner certain features of the multiphase system."

THE THREE-PHASE MOTOR.

"The non-synchronous motor becomes, by proper proportioning, practically capable of maintaining a speed which does not vary over a few per cent. from light to full load; it requires no exciting current, and starts under load. In construction it is simply a structure in which the rotating field set up by the three currents of a three-branched suitably arranged conductor in a laminated iron mass, called the field, drags around a movable armature carrying a system of closed conductors, in which strong currents are set up by the moving lines from the field, which acts to close its magnetic circuit through the armature iron. Thus the rotating bundles of magnetic lines, in cutting the armature conductor, push such conductor along by virtue of the reaction of the opposing currents set up in the armature conductors or closed circuit. Such motors, not being reversed dynamos, cannot act to generate current if revolved by power. Their great advantage is that they may be placed anywhere where convenient to receive current from the mains direct, as from transformers; they may be started or stopped at will, and have no commutators."

CONVERTING MULTIPHASE INTO CONTINUOUS CURRENTS.

Continuing, Prof. Thomson says: "There is another important way in which the three-phase currents may be utilized at the receiving end. They may be readily transformed into continuous currents of low potential, or of any potential practicable for commutation. The means for transformation in this case is a motor generator of special construction. It possesses an armature winding and connections, suitable for three-phase currents, a field magnet excited by continuous current from any suitable source and acting upon the armature, a secondary winding on the armature, or the same winding as that connected to the three-phase mains, with the usual connections to the segments of a continuous current commutator, upon which brushes suitably adjusted take off continuous currents. These may be used for lighting, for running continuous current motors, etc. Motor generators giving 500 volts continuous current, 220 volts and 110 volts, are easily worked from the same system of three-phase mains. The excitation of these machines may be obtained from their own commuted currents. They are self-propelling after having been started along with the generating plant, or may be easily brought to speed before connecting with the three-phase supply by continuous currents from another machine at work. They can be compounded for drop of potential in themselves and the lines leading to and from them."

SUPPLY OF ELECTRICITY IN A LARGE CITY.

The future supply of electricity in a large city for all purposes, at any desired voltage of continuous or alternating current, would involve a system as follows:

A generating station conveniently located for obtaining water for condensing, cheap fuel delivery and ready disposal of ashes; containing huge triple compound condensing engines driving large dynamos; delivering either directly or through transformation high potential three-phase currents, probably consisting of sets of three conductors with a heavy open braid or network covering, tightly woven on, and drawn into an iron pipe filled with insulating oil, placed underground to avoid atmospheric disturbances; sub-stations containing compounded three-phase motor generators feeding into the street mains at the desired potential for lights and continuous current motors; motor generators feeding currents of suitable potential for street car propulsion; alternating current transformers delivering currents of alternating character at the desired voltage for lighting, and for driving commutatorless three-phase motors.

There is no electrical service which could not receive its supply from such a system. The time is, perhaps, not quite ripe for such a comprehensive scheme, but its advantages are obvious to those familiar with the present conditions of supply in large cities.

HIGH POTENTIALS AND INSULATION.

Prof. Thomson asks the question, "What are the highest potentials which can ever be made available in electric transmission?" Any answer to this, says the professor, will necessarily imply foretelling the future practice, a very hazardous thing to attempt. Such answer may, however, be taken to relate to either a single-phase alternating system or a multiphase, the only difference being in the number of conductors employed.

With regard to insulation, a layer of good insulating oil, one inch thick, between rounded smooth metal surfaces, will equal, in resistance to puncturing, a potential which will cause a spark in air over 30 inches long. Professor Thomson's tests in this direction point to an approximate relation of one to 35 or 40 in dielectric strength between air and good heavy paraffine oil. As nearly as can be estimated, a spark between rounded surfaces at 30 inches in air represents not less than 500,000 volts, and experiments go to show that such potentials can be "kept down," so to speak, in a bath of oil. Whether the condenser effects of a long line would introduce serious difficulties it is impossible to say, but provided that the rate of alternation or periodicity be kept low and the insulation maintained by covering every inch of the high pressure conductors in, say, two inches thick of oil, it might even be possible to work with 500,000 volts. Such a line is even safer, so far as life risks are concerned, than an overhead line of much less pressure. In fact, it may be said to be practically safe. Any interference with the line is difficult on account of the pipe inclosing it, and on the first weakening of the insulation, or before a break in the pipe became complete, a short circuit of a moderate current would take place, and the fuses be blown at the ends of the line.

COST OF GENERATION AND DISTRIBUTION.

Mr. W. Lahmeyer, in a recent paper read before the Electrotechnical Society of Berlin, referred to the important bearing which a system of electrical distribution from large central stations would have upon industrial undertakings in general, and upon the prosperity of a manufacturing nation in particular. Before the introduction of the multiphase system there were several well-known difficulties in the way of high tension transmission. The practicability of potentials from 15,000 to 30,000 volts has been fully demonstrated in the case of the Lauffen-Frankfort installation, but too much stress has been laid upon the aid of cheap water power, and nearly all the speculations centred upon the utilization of waterfalls. The value attached to the generation of electricity by steam power on a large scale has hitherto received too little attention. Many people have not realized the fact of the great difference in the cost of generating power on a large scale and that produced on a small scale.

Professor Salomon compiled Table I., calculated from practical data, which shows the cost of a horse-power hour produced by steam engines of various dimensions with 1,000 and 3,000 working hours per annum. The cost of coal was assumed at 14s. 3d. per ton, and the usual expenses connected with maintenance allowed for. It matters little, for the purpose of this table, what the local conditions as to wages and maintenance may have been, because the relative values will remain the same.

With 1,000 working hours per annum, the cost of a horse-power hour in a 2.5-h. p. engine amounts to nearly fourpence. This will be thought too high by those who do not allow for depreciation of the plant. In an installation of 50 h. p. the cost is at once reduced to 1.21 pence, and in one of 1,000 h. p. to .7 of a penny, while a 10,000-h. p. plant can produce the horse-power hour for a little more than half a penny. This shows the well known advantage of generating power on a large scale and distributing it if the cost of and loss in the distribution are small.

In comparing the figures obtained in central stations with a large number of working hours, the economy is much more apparent. The question then will be, what is the loss in energy, and the greater cost of distributing power from a central station to consumers at various distances? Calculations were made for a 10,000-h. p. plant for the distribution of electrical energy over a district having a diameter of 100 kilometres, or 62.14 miles. The costs of such a central station, using the three-phase system, are about as follows:

Buildings and steam plant	£100,000
Distributing mains	45,000
Electric plant	100,000
Total	£245,000
Or in round figures	£250,000

The total length of aerial line in this case is supposed to be 300 kilometres (186.42 miles); there will therefore be 900 kilometers (559 miles) of wire. The price of power in Table II., referring to this installation, is calculated at the receiving points, full allowance being made for the losses in conversion, as also for depreciation. This table shows that current can be generated at the astoundingly low rate of .48 of a penny per horse-power hour. The distribution of power over such a large area is scarcely desirable, although the size of the plant may be quite feasible. By distributing the current over a smaller area, the cost will naturally become smaller, and lower potentials than those assumed could be used. The correctness of these figures need not be doubted, but they depend upon the necessity of using overhead conductors. This is the point upon which the whole question turns. In towns there is little sympathy to be expected for overhead lines. But we must try to utilize the great arteries along which commerce flows, the high roads and the railways, for the transmission of power.

Table III. was originally prepared by Mr. Dihlmann, chief engineer of Messrs. Siemens & Halske, and is converted into English equivalents; it shows the relative costs of overhead and underground conductors when used for the high tension three-phase system. The differences in the case of small powers and short distances are not considerable, because the costs are in a measure dependent upon insulation, and for mechanical reasons the diameter of the overhead wire has to be larger than necessary for the given current. Mr. Dihlmann made the mistake in assuming that 10,000 h. p. would be transmitted through one circuit. The idea is to distribute the energy round about the central station. In the case of 1,000 h. p. being transmitted to a distance of 100 kilometres (62.14 miles), the underground cable would cost ten times as much as overhead bare conductors.

If overhead conductors are prohibited, then the question of transmitting such units as 10,000 h. p. becomes problematic.

With regard to safety, everything points in favor of aerial lines, and the only accident which happened in the Lauffen-Frankfort experiment was in the generating station, and not on the line. There is no difficulty in using potentials of 30,000 volts, if the insulators are tested before being put up. The fact that a few insulators broke down with this potential counts for nothing; we might just as well say that steam boilers must not be used because somehave exploded.

TABLE I.

Cost of 1 h. p. hour in pence for steam engine installations, coal costing 14s. 3d. per ton.

In small installations without condensation.

	H. P.	2.5	5	10	25	50	100
Annual working hours	1,000	3.936	3.156	2.54	1.649	1.212	1.008
" " "	3,000	2.460	1.932	1.54	1.032	.762	.690

In central stations with condensation.

	H. P.	500	1,000	2,000	5,000	10,000
Annual working hours	1,000	.822	.704	.652	.570	.509
" " "	3,000	.506	.461	.432	.380	.324

TABLE II.—CENTRAL STATION FOR 10,000 H. P.

Diameter of district to be supplied, 62.138 miles (100 kilometres). Cost of installation, including conductors and secondary stations, £250,000. Cost of current in pence at the point of delivery, with coal costing 14s. 3d. per ton.

Annual working hours.	For one kilowatt hour.	For 1 h. p. hour in the case of large motors.
1,000	1.680	1.423
3,000	.936	.790
5,000	.744	.631

Cost of current in pence at point of delivery, with coal costing 5s. per ton.

Central Station, near coal mine.

Annual working hours.	For one kilowatt hour.	For 1 h. p. hour in the case of large motors.
1,000	1.495	1.260
3,000	.750	.636
5,000	.566	.480

TABLE III.

Cost of conductors for power transmission with three-phase current and tensions up to 20,000 volts, with 15 per cent. loss on a maximum load:

(1ST). FOR 100 H. P.

Km.	Miles.		Section of wire. Square inch.	Cost in £. £ s.	£ per H. P. £ s. d.
10	6.214	O	3 wires .0062	356 16	3 11 4
		C	3 " .0155	4,825 0	48 5 0
20	12.428	O	3 " .0062	713 12	7 2 8
		C	3 " .0155	9,650 0	96 10 0
50	31.070	O	3 " .0062	1,784 0	17 16 9
		C	3 " .0155	24,125 0	241 5 0
100	62.140	O	3 " .0062	3,568 0	35 13 7
		C	3 " .0155	48,250 0	482 10 0
150	93.210	O	3 " .0062	5,352 0	53 10 5
		C	3 " .0155	72,375 0	723 15 0
200	124.280	O	3 " .0062	7,136 0	71 7 2
		C	3 " .0155	96,500 0	965 0 0

(2D). FOR 200 H. P.

Km.	Miles.		Section of wire. Square inch.	Cost in £. £ s.	£ per H. P. £ s. d.
10	6.214	O	3 wires .0062	356 15	1 15 8
		C	3 " .0155	4,825 0	24 2 6
20	12.428	O	3 " .0062	713 12	3 11 4
		C	3 " .0155	9,650 0	48 5 0
50	31.070	O	3 " .0062	1,784 0	8 18 5
		C	3 " .0155	24,125 0	120 12 6
100	62.140	O	3 " .0062	3,568 0	17 16 9
		C	3 " .0155	48,250 0	241 5 0
150	93.210	O	3 " .0062	5,352 0	26 15 2
		C	3 " .0155	72,375 0	361 17 6
200	124.280	O	3 " .0093	8,204 0	41 0 5
		C	3 " .0155	96,500 0	482 10 0

(3D). FOR 500 H.P.

Km.	Miles.		Section of wire. Square inch.	Cost in £. £ s.	£ per H. P. £ s. d.
10	6.214	O	3 wires .00620	356 15	0 18 0
		C	3 " .01550	4,825 0	9 13 0
20	12.428	O	3 " .00620	713 10	1 8 7
		C	3 " .01550	9,650 0	19 6 0
50	31.070	O	3 " .00620	1,784 0	3 1 5
		C	3 " .01550	24,125 0	48 5 0
100	62.140	O	3 " .01085	4,369 0	8 14 9
		C	3 " .01550	48,250 0	96 10 0
150	93.210	O	3 " .01550	7,755 0	15 10 0
		C	3 " .01550	72,375 0	144 15 0
200	124.280	O	3 " .02015	11,942 0	23 17 8
		C	3 " .02015	101,500 0	203 0 0

(4TH). FOR 1,000 H. P.

Km.	Miles.		Section of wire. Square inch.	Cost in £. £ s.	£ per H. P. £ s. d.
10	6.214	O	3 wires .00620	357 0	0 7 2
		C	3 " .01550	4,825 0	4 16 6
20	12.428	O	3 " .00620	713 10	0 14 3
		C	3 " .01550	9,650 0	9 13 0
50	31.070	O	3 " .01085	2,184 10	2 3 8
		C	3 " .01550	24,125 0	24 2 6
100	62.140	O	3 " .02015	5,971 0	5 19 5
		C	3 " .02015	50,750 0	50 15 0
150	93.210	O	3 " .03100	11,760 0	11 15 8
		C	3 " .03100	85,125 0	85 2 6
200	124.280	O	3 " .04030	18,884 0	18 17 8
		C	3 " .03875	183,000 0	183 0 0

(5TH). FOR 10,000 H. P.

Km.	Miles.		Section of wire. Square inch.	Cost in £. £ s.	£ per H. P. £ s. d.
10	6.214	O	3 wires .02015	595 0	0 1 2
		C	3 " .01025	5,075 0	0 10 2
20	12.428	O	3 " .04030	1,890 0	0 3 9
		C	3 " .03875	12,200 0	1 4 5
50	31.070	O	3 " .10850	10,590 0	1 1 2
		C	3 " .10850	98,753 0	9 17 6
100	62.140	O	3 " .20150	37,210 0	3 14 5
		C	3 " .20150	127,500 0	12 15 0
150	93.210	O	3 " .31000	83,850 0	8 7 8
		C	3 " .31000	337,500 0	33 15 0
200	124.280	O	3 " .40300	143.840 0	14 7 8
		C	3 " .40300	603,500 0	60 7 0

"O" means overhead line. "C" means underground cable.

Note on Pollak's System of Sectional Conduit Roads.

In our issue of June 4, 1892, p. 387, there was published a note by Mr. F. Bolling replying to one previously published by Mr. Pollak, regarding the priority of invention of the sectional conduit railroad. In reply to this note Mr. Pollak has written us again from Frankfort, Germany, saying that his system was described in detail in the *Bulletin de la Société Internationale des Electriciens* in 1887, also in *La Lumiere Electrique*, April 16, 1887, and in many other papers as well as in French, German and other patents. He claims that the system of Messrs. Ayrton and Perry, described in their English patent 2,295, of 1883, is a series system, and that it does not infringe on his fundamental claims,

*From the *Electrical Review*, London. For the first and second articles of this series see THE ELECTRICAL WORLD of May 21 and June 11, 1892.

Carbons.*

BY H. O. FISK.

It was suggested at one of our committee meetings that I should prepare a paper for this convention on "Carbon Testing," but the time was too short to carry out a series of experiments as at first spoken of, so instead I have prepared a short description of the process of manufacture of carbon points, as conducted at the factory in Peterborough.

Carbon is an elementary substance, occurring in nature uncombined, as the diamond and mineral plumbago. It is much more abundant, however, in a state of combination; thus it occurs in union with oxygen in the carbonic acid present in the atmosphere, and in combination with oxygen and calcium forms in the shape of limestone a large portion of the earth's crust. In union mainly with hydrogen, it is the chief constituent of coal and mineral oils, and along with oxygen, hydrogen and nitrogen, is an abundant ingredient of animals and still more so of plants. It exists in several allotropic forms, that is, forms which differ from each other in many physical and some chemical properties, but which nevertheless consist of nothing but single element.

Wood carbon, or charcoal, is prepared for heating wood in iron retorts as long as it evolves anything volatile. When coal is treated in the same manner, as it is in the manufacture of coal gas, the excess of carbon is in like manner left behind, forming a hard shining light solid, valued as an economical and powerful fuel. This substance, which is literally charred coal, and therefore best deserves the title of charcoal, goes nevertheless by the name of coke. A variety of this material is found in the upper parts of the gas retorts, and is probably formed by the decomposition of gaseous compounds of carbon and hydrogen. It is very hard and porous, with almost a metallic lustre, and is a good conductor of heat and electricity, but this is of little value, if any, in the carbon business. However, 25 per cent. of this coke mixed with 75 per cent. of petroleum coke is said to make a good carbon for low tension work. Another variety of this material is obtained from the oil regions, commonly known as petroleum coke. This is a by-product of the oil stills, and is the only kind used to any great extent in the manufacture of carbon points for the electrical industry. It is of primary importance that the coke, and in fact all the ingredients used, be absolutely free from impurities. Sulphur, iron and dirt (by dirt I mean shale, sand and other foreign matter which by careless handling may get in) are the impurities frequently met with, but sulphur is by far the worst the carbon maker has to contend with; but by using the very best of coke which is obtained from Pennsylvania oils, trouble from this source is reduced to a minimum. The other constituent of our carbon is pitch. This is made from coal tar, which is a by-product of the gas retorts. It may also be obtained from blast furnaces, but this kind is more or less contaminated with iron, and therefore is unfit for this class of work. Pitch for this particular purpose is difficult to obtain, as the makers do not care to expose their still to the high temperature necessary to drive out all of the oil, and reduce it to the proper specific gravity, and as the men in the factory say, "It is more or less wet."

The first step in the process of manufacture is that of crushing the coke. This is accomplished by means of a machine somewhat in appearance like a mammoth coffee mill. The coke comes from this crushed to about the size of coarse gravel; it is then automatically elevated to a large bin in the upper part of the factory, and from there it is conveyed to a large iron hopper situated directly over the calcining retorts. Into these the granulated coke is conducted by means of spouts with gates arranged to control the flow of material into the several afore-mentioned retorts. They are then sealed up, thereby preventing combustion, with the exception of a few vents to allow of the escape of gas, arising from the heating of the coke to a state of incandescence, which point is reached in from 24 to 48 hours after firing. After this if the coke is not pure it will be found to have caked, necessitating in some cases the use of bars to break it up sufficiently to allow of it being drawn from the retorts. If pure it will appear crisp and dry and to have suffered a loss in weight of about 30 per cent. After retorts have been drawn sufficiently long to allow of cooling, their contents are elevated to the milling department and run through a set of French buhr stones incased in iron, very similar to the grist mill chop stones; then through a silk bolter separating the coarse from the fine, the former returning to the milling machine, the latter being conveyed to bins with suitably arranged spouts over scales, from which it may be drawn and weighed as required by the mixing department. We will leave the coke here for the present and return to the other ingredient, namely, the pitch. This is a dense, hard solid, very brittle and dry, and in appearance somewhat resembling gutta percha. This material, when it reaches the factory, is incased in casks, holding about 600 pounds each. It is then broken up by the men into a convenient size for handling, and subjected to a granulating process similar to that of the coke; finally we find it at a spout close beside the one from which the coke can be drawn.

We have now followed the two principal ingredients through the various processes which were necessary to prepare them for the mixing room. The other ingredients, if any, we shall not be able to elaborate upon until we have reached a more confidential relationship with the carbon makers. However, upon the manipulation of the materials at this stage I am told the success of the future carbon greatly depends in fact the great secret lies: in the mixing. We can better understand the skill and care required to properly amalgamate the mixture when we learn that each particle or grain of coke must have its individual coating of pitch, and it may be interesting to learn that this coke is ground so fine that a grain magnified a thousand times would only appear the size of a shot. To obtain these results the materials are carefully proportioned by weight and placed in a mixing barrel. This is a rotating cast iron cylinder within which in the same direction revolves an independent shaft, twice as fast as the cylinder, to which are attached arms so arranged that every part of the barrel is covered or swept in each revolution. This is attached to a furnace in such a way that the flues follow the whole circumference of this barrel, maintaining a uniform temperature of about 300 degrees Fahr., which is necessary to bring the pitch to a state sufficiently plastic for amalgamation. Thirty minutes is the time required for each batch, which would make about 1,600 carbons. From this machine it is taken to the cooling room, and spread out for 10 or 12 hours to cool. Here the mixture solidifies to such an extent that it becomes necessary to pulverize it again, to perfect it for the molds. This end is attained by means of a mill, the pulverizing feature of which is two discs 30 inches in diameter, with corrugated face plates revolving in opposite directions at the rate of 1,500 revolutions per minute (about $\frac{1}{100}$ of an inch apart). From this it is once more passed through a bolting machine, and then, finding its way down gravity tubes to a bin on the floor below (which is the molding room), it is carefully weighed out by the workmen on peculiar little scales with clock-like dials, in quantities just sufficient to fill each mold as it comes hot from the oven. It having been previously lubricated with some heavy oil is now ready for its charge, which the operator places in it and works evenly over the whole surface with a spatula, to insure uniformity of density. The cover or top half is placed in position and the mold and its contents pass for a few moments into an oven, the temperature of which is about 300 degrees Fahr. As soon as the mixture has become quite adhesive the mold is placed in the hydraulic press, and subjected to a pressure of several hundred tons. This press consists of a cylinder and base, kept in position by four steel columns weighing nearly a ton each. Within this cylinder (which is eleven inches thick and copper lined) is a ram or plunger thirteen inches diameter, making a stroke of three inches. Connected with this press by a feed and return pipe is a triple cylinder pump very powerfully geared, pumping a stream of water continuously through the feed pipe, press cylinder and return pipe. By simply closing the valve at the press on the return pipe, the pressure at once begins to accumulate under the ram, and in fifteen seconds the enormous pressure of 20,000 pounds per square inch is attained. Then the release valve is opened, and the whole apparatus, as though possessed of life, gives a groan of relief. The mold is now removed and opened, and we have a corrugated card containing 16 or 18 carbons, each one being joined to its neighbor by a fin, which is inevitably formed when subjected to the enormous pressure before mentioned. These cards are placed on plates, which are fitted to receive them perfectly. These plates with their contents are piled up and weights placed thereon to prevent warping. When cool they are broken apart, gauged for size, culled, and the fin scraped off. They are then laid in the furnace for baking. This furnace is rectangular in shape, 34 by 11, four feet deep and made of fire brick, and is similar to a large vat set about two-thirds below the surface of the earth. Over this when filled is placed a dome-shaped cover, sufficiently high above the sand and tile which covers the carbon to allow of a free passage of the flames, and which is continued by flues back through the sides and also underneath, thus completely enveloping the body of the furnace in flames. The carbons are carefully placed in the furnace and separated from each other with washed sand, which is brought from the shores of Lake Ontario. Some days are required to completely load a furnace, as each section will hold about 75,000 carbons. The cover having been placed in position and sealed with fire clay, the fire is now started, crude oil being the fuel used, as well as in the case of the retorts and molders' oven. The supply is held in a 250 barrel tank by a railway siding some 200 feet from the building, and connected by underground pipes to the various points in the factory where required, each branch terminating in a patent burner, which to the writer very much resembles a huge lineman's torch, with the exception that steam is used to spray the oil and perfect the combustion. This fire is continued moderately for 48 hours to allow of the gas escaping without blistering the carbon; it is then forced to its utmost for from forty-eight to sixty hours longer, then shut off, and the whole allowed to cool for forty-eight hours before uncovering. The top, which is mounted on wheels, is then rolled off and a few carbons taken from various parts of the furnace and tested by a Wheatstone bridge and galvanometer for resistance, as this at once determines if the baking has been carried sufficiently far. If the measurements of all the samples exceed four-tenths of an ohm, the furnace is re-covered and fired for some hours longer, but this very rarely has to be done. The writer recently tested samples from the north and south end and centre of a furnace, and they measured 23, 22 and 24 one-hundredths of an ohm respectively. Some difficulty was at first experienced in attaching carbon to the bridge, for the resistance of this substance, as you are all well aware, varies considerably, as the pressure of contact, and the same carbon measured at different times would often vary several hundredths of an ohm. But an instrument was designed by the writer which obviated to a great extent, if not wholly, this trouble. The pressure brought to bear on the sample undergoing test by this instrument is determined by small weights suspended from levers attached to holders so arranged that exactly the same pressure and contact is formed on different samples of the same size. If the resistance of the samples as before mentioned shows that the contents of the furnace have been sufficiently baked, it is unloaded, the hot carbons being handled with forks. When cold they are sorted, the firsts and seconds being easily determined by rolling on level steel plates.

After this inspection they are ready for the plating room, where they receive their copper coat by being hung in leaden vats containing a saturated solution of sulphate of copper. These vats, of which there are several dozen, are connected in series with a 20-ampère constant current dynamo. Twenty minutes to half an hour is the time required to complete this plating process. They are then washed in hot and cold water and placed on racks to dry, after which they go to the packing department to be rolled in paper and boxed for shipment.

I am indebted for a great deal of the above information to Mr. Taylor, the genial manager, who not only patiently answered my many questions, but allowed me, with camera, perfect freedom throughout the entire factory, thus enabling me to obtain and show photographs of some of the apparatus which will give a far better idea of the same than the meagre description you have just listened to.

* A paper read at the first annual meeting of the Canadian Electrical Association.

Electro-Metallurgy.—VI.*

BY F. M. F. CAZIN.

In the preceding discussion it has been shown, that from different compounds, containing the same metal in different proportions, different quantities of the metal are disengaged by the same or equivalent electric energy.

A method must therefore be found, by which in each given case we may determine the quantity of metal disengaged at the cathode per ampère-second, or per ampère for any multiple of the second.

Electro-galvanic and electrolytic research started with the decomposition of water. Its composition as well as its decomposition have become the normal cases, with which all other analogous cases of electrolytic decomposition are now compared. And yet there exists also this other reason of a purely scientific nature, for this selection and preference, viz., that the atomic weight of hydrogen serves as the unit for all others.

For a long time the question was not mooted, whether quantity of metal disengaged be proportionate in all other cases than in the decomposition of so-called binary compounds to either the one or the other of the two components, when compared with the results obtained in dealing with binary compounds. When the question was raised later on, the false conclusion was advanced that the metals were deposited at a fixed proportion, viz., at the rate of their atomic weight multiplied by a fixed coefficient, called the metal's valency, there being no room left for variation in quantity of metal deposited per ampère for the same metal.

But when it was discovered that under different conditions of compound the quantity of deposit varied for the same metal, even under the application of the same current, then it clearly appeared that the metal as such did not affect the quantity of its deposit per ampère per unit of time. But it was experimentally ascertained that the quantity of metal disengaged depended solely on a weight unit of negative matter disengaged, and on the proportion in which the metal is present in the compound to the assumed weight unit of negative matter.

In the search to be instituted on the basis of the fact thus ascertained for a general equation, giving the quantities in all cases of matter electrolytically disengaged per ampère-second, a number of general and partly new values will have to be employed. It is therefore opportune at this place to give a list of symbols for these values.

SYMBOLS.

$R(_1)$	signifying	electric pressure in volts.
Ht	"	the comparative, constructive or proportionate caloric effect of chemical reaction expressed by $Ht = h\,t(_1)\,A\,W\,P \times c\,P$.
$h\,t$	"	the caloric effect of chemical reaction in forming the compound and relating to one weight-unit of the negative matter (oxygen, etc.) by $h\,t = h\,t(_1) \times \frac{A\,W\,P \times c\,P}{A\,W\,N \times c\,N}$
$h\,t(_1)$	"	the caloric effect of chemical reaction in forming the compound and relating to one weight-unit of the positive matter (metal, etc.) by $h\,t(_1) = \frac{Ht}{A\,W\,P \times c\,P} = h\,t \times \frac{A\,W\,N \times c\,N}{A\,W\,P \times c\,P}$
$H\,t(_1)$	"	the caloric effect of chemical reaction in forming the compound and relating to one weight-unit of the compound, by $H\,t(_1) = \frac{h\,t(_1)}{A\,W\,P}$
Q	"	quantity of positive matter disengaged in electrolytic action per second-ampère.
$Q(_1)$	"	proportionate quantity of negative matter.
M	"	the total quantity of (positive matter) metal disengaged per second in grammes.
$M(_1)$	"	the same without time limit or $= M \times t$.
$A\,W\,P$	"	atomic weight of positive matter.
$A\,W\,N$	"	" " " negative matter.

* For the previous section of this article see THE ELECTRICAL WORLD of June 4, 1892, p. 385.

cP	signifying	coefficient of positive element.
cN	"	coefficient to the (atomic) equivalent weight of the negative element.
eD	"	electric density as a general value.
δ	"	density of metal.
ED	"	electrolytic density, viz., the thickness of metal deposited on one square decimetre per ampere second.
F	"	face of electrodes in square decimetres as unit.
t	"	number of seconds (hour = 3,600).
$ED_{(1)}$	"	the thickness of metal deposited per ampère-second on any number of square decimetres by $\frac{ED}{F} = ED_{(1)}$.
ee	"	caloric coloring by $ee = \frac{Ht}{cc}$ = volts.

The author may also at this point of the discussion introduce a table of metal compounds and of their real valencies, the weights considered being those of metal disengaged per ampère-second, etc. The table itself is of service and importance in all electrolytic and electro-metallurgical practice, a fact which will appear more evident by some references to be made later.

II.—TABLE OF METALS WITH THEIR ATOMIC WEIGHTS, ELECTRO-CHEMICAL EQUIVALENTS, WEIGHTS PER AMPERE SECOND AND MINUTE, THEIR ELECTROLYTIC DENSITIES (THICKNESS DEPOSITED) PER SQUARE DECIMETRE PER AMPERE-SECOND, HOUR AND DAY, BOTH BY THEORETICAL AND EXPERIMENTAL VALUES.

1. Metal.	2. Compound from which the metal is electrolytically evolved.	3. Atomic weight of positive matter (metal) = AWP.	4. Divisor to make weight proportionate to ½. $= + \frac{cP}{2 \times cN}$.	5. Electro chemical equivalent, or weight of metal deposited in electrolysis per ampère-second in 0.00001 gm = Q.	6. Weight as made to conform with experimental results of Kohlrausch per ampère-second in 0.00001 gramme by adding 5 per cent. to Q.	7. Weight (by Kohlrausch) in gr. of metal deposited in electrolysis per ampère-minute, gm.	8. Density of metal.	9. Electrolytic density or thickness of cathion per 0.1². Theoretical values. Per ampère-second in mm. (= ED) = $AWP \times \frac{cP}{2.cN} \times \frac{1}{\delta} \times$ 0.000001 in mm = ED.	10. Per ampère-hour in mm. (= $ED \times$ 3,600).	11. Per ampère 24 hours in mm. (= $ED \times$ 86,400).	12. Experimental values (Kohlrausch) per hour-ampère in mm.
Hydrogen	H_2O	11.00	.....	1.000	1.05*	.....	.....	.....	.....	.....	.....
Silver	Ag_2O	107.66	.....	107.666	113.05	0.0678	10.80	0.00000999	0.03691	0.88586	0.03875
Lead	PbO	206.40	+ 2	103.200	108.36	0.0650	11.40	0.00000905	0.03259	0.78218	0.03421
Mercury	HgO	199.80	+ 2	99.900	104.90	0.0629	13.50	0.00000740	0.02646	0.63513	0.02778
Bismuth	Bi_2O_3	207.00	+ 3	69.000	72.45	0.0435	9.80	0.00000704	0.02535	0.60834	0.02632
Gold	Au_2O_3	394.70	+ 3	65.566	68.84	0.0413	19.32	0.00000339	0.01222	0.29316	0.01283
Copper	Cu_2O	63.20	.....	63.200	66.40	0.0398	8.80	0.00000718	0.02586	0.62052	0.02716
Tin	SnO	117.50	+ 2	58.750	61.69	0.0370	7.30	0.00000805	0.02898	0.60535	0.03042
Silver	AgO	107.66	+ 2	53.833	56.52	0.0339	10.80	0.00000498	0.01845	0.44293	0.01937
Platinum	PtO_2	194.30	+ 4	48.575	51.00	0.0306	21.40	0.00000227	0.00817	0.19613	0.00858
Antimony	Sb_2O_3	119.60	+ 3	39.866	41.86	0.0249	6.70	0.00000395	0.02142	0.51408	0.02249
Zinc	ZnO	64.90	+ 2	32.900	34.54	0.0207	7.10	0.00000463	0.01668	0.39165	0.01751
Gold	$AuCl_3$	196.70	+ 6	32.783	34.42	0.0206	19.32	0.00000170	0.00611	0.14658	0.00641
Copper	CuO	63.20	+ 2	31.600	33.20	0.0199	8.80	0.00000359	0.01293	0.31026	0.01358
Tin	SnO_2	117.50	+ 4	29.375	30.84	0.0185	7.30	0.00000402	0.01448	0.34767	0.01521
Cobalt	CoO	58.60	+ 2	29.300	30.76	0.0185	8.50	0.00000345	0.01241	0.29782	0.01303
Nickel	NiO	58.60	+ 2	29.300	30.76	0.0185	8.60	0.00000341	0.01227	0.29436	0.01288
Iron	FeO	55.90	+ 2	27.950	29.35	0.0176	7.80	0.00000359	0.01290	0.30957	0.01354
Iron	Fe_2O_4	55.90	+ (4⅔)	20.962	22.01	0.0132	7.80	0.00000269	0.01720	0.23218	0.01806
Cobalt	Co_2O_3	58.60	+ 3	19.533	20.51	0.0123	8.50	0.00000231	0.00827	0.19855	0.00868
Nickel	Ni_2O_3	58.60	+ 3	19.533	20.51	0.0123	8.60	0.00000227	0.00818	0.19624	0.00859
Iron	Fe_2O_3	55.90	+ 3	18.633	19.58	0.0117	7.80	0.00000239	0.00860	0.20638	0.00903

* If the proportionate value to 0.000332 Cu be assumed for H, then this value would not be as 0.0000105, but the further decimals .063291 + would have to be added to render the 1.05 in per cent. milligramme correct, and if the commonly accepted quantity per ampère of Cu as 0.00033 be accepted as a standard, then the value for H could only be as 0.000010443.

† Hydrogen = 1 being made the basis for electro-chemical equivalents, it is quite necessary that, with all further conclusions based on the electrolytic behavior of water, the basis for all electro-chemical equivalents should at the same time be as ½O, or as 1 negative element to 2 positive elements in equivalents.

As in the preceding little table, so in this one, all values are constructed on the basis that has been established both theoretically and experimentally for the relation between the ampère and the quantities of H, Ag and Cu disengaged from *stated* compounds, and mainly the quantities of hydrogen and copper proportional to the ampère-second. In chemistry and in electrolysis hydrogen assumes the value as a unit of comparison, and the close relation between the two leads to the almost unavoidable conclusion, that, if the ampère-second is not as yet considered as the electric current which disengages 0.00001 gm. of hydrogen from its compound H_2O, this quantity of 0.00001 gm. of hydrogen or its equivalent of 0.000316 of copper should soon become and be considered as the qualification of the ampère-second or coulomb.

And even, if in order to accept this valuation of the current-unit ampère there must take place a reduction of 2 per cent. to 5 per cent. in the unit thus expressed, as against the customary one expressed in electrical instruments of measurement, even then its acceptance produces so many advantages in theory and practice that the discrepancy is no valid cause for its rejection, as long as similar discrepancies exist between the customary units themselves.

Under this assumption the ampère-second would find, in place of a measurement by one or by a few experimental quantities of positive matter disengaged, about the quantity of which there are as many different statements as there are experimenters (Kohlrausch, Siemens, Casselmann, Weber, etc.), a general value, which is represented by the following equations:

*Quantity of metal disengaged per 1 ampère second =

$$Q = \begin{cases} \frac{H_2}{2} \times 0.00001 = 0.00001 \text{ gm.} \\ \frac{Cu}{2} \times 0.00001 = 0.000316 \text{ gm.} \\ \frac{AWP \times cP}{2cN} \times 0.00001 = AWP \times \frac{cP}{2cN} \times 0.00001 \end{cases}$$

The quantity of metal deposited per ampère-second rates for all metal compounds as analogous to hydrogen disengaged from the compound H_2O. The proportion between negative and positive matter is in this case as

$$AWN + AWP \times cF = 15.96 + 1 \times 2 \text{ or as}$$

$$\left.\begin{array}{l} \frac{AWN}{2} + \frac{AWP \times cP}{2} \\ \frac{O}{2} + H \end{array}\right\} = 7.98 + 1$$

If, therefore, this proposition remains normal for other hydrogen or copper per ampère-second has as yet been firmly agreed upon, because all determinations started on experimental and not theoretical values. The two latest authorities in the premises, Kohlrausch and Siemens, vary, the one having an excess of 5 per cent. and the other of 2 per cent. only over the one calculated by the preceding equation on a theoretical unit of 0.01 milligramme of hydrogen, in place of their values of 0.0105 and 0.0102 milligramme respectively.*

If I have evolved the values, as stated, in inverse order to the one maintained since Faraday's time, that is, not proceeding as hitherto practiced from merely experimental values, I have thereby been relieved of the necessity of employing such indefinite equations as

$$\text{Coefficient of Valency} = \left\{\frac{\text{Electro-chemical equivalent}}{\text{Chemical equivalent}}\right\} = \begin{cases} 0.00001021 \\ 0.00000511 \\ 0.00000340 \\ 0.00000255 \end{cases}$$

in which equation the value for electro-chemical equivalent itself is indefinite, the quotients in their turn being erroneously assumed to apply each in a stable relation to some of the metals, namely:

0.00001022 to Ag; 0.00000511 to Pb, Fe, Co, Ni, Cu, Hg, Zn, Sn; 0.00000340 to Sb, Au; 0.00000255 to Pt.

In evolving the value for electrolytical equivalent directly from chemical equivalents by the equation

$$\text{Electrolytical equivalent} = \frac{AWP}{2} \times \frac{cP}{cN}$$

and for quantity of metal disengaged per ampère-second by

$$Q = \frac{AWP}{2} \times \frac{cP}{cN} \times 0.00001$$

and by the assumption of 100,000 current-units disengaging 1 gm. of hydrogen per second, all indefinite values were set aside.

G. Gore, of all authors who have written on this subject, comes nearest to the truth, simply because he expands the line of valencies from monads to hexads, failing nevertheless to show the true relations of electro-chemical equivalent to chemical equivalent as exclusively represented and here first stated in the equation

$$Q = \frac{AWP}{2} \times \frac{cP}{cN} \times 0.00001 \text{ gm.}$$

7.—THE RELATION BETWEEN CURRENT AND ELECTRODES.

If in the preceding sections we have been investigating the relation of general electric values to electrolytic action and effects, we now come to the question of electrolytic apparatus.

The first question in this connection that presents itself is the one relating to dimensions of essential parts of electrolytic apparatus. Such apparatus in its simplest and most primitive form is the cell, and the influence exercised by the dimensions of its parts therefore should first be discussed. When the action of the cell, which sets free electrolytic energy, is once well understood, then its substitution by the dynamo will easily be made intelligible. And, again, from the active cell we must derive the full understanding of the passive cell or of the electrolytic bath.

As there is no more essential part of the cell than the electrodes, their relation to the cell's action deserves our first attention.

From what has preceded it is beyond doubt, that the electric pressure of the cell depends on the chemical reaction taking place therein.* As such chemical reaction takes place uniformly whether small or large electrodes are employed, their dimension has no influence on the quality of electrolytic action, and it is easy to show that such dimension is of influence only on the quantity of electrolytic action. This fact once understood the relation between the electric quantity or current and the face-area of the electrodes demands investigation.

When cells are connected in multiple (not in series), the effect is a multiplication by their number of the quantity of metal disengaged—or, in other words, a multiplication of the current supplied by a single cell, while the quality of their action remains the same as it was for the singlecell.

To arrange cells abreast is equivalent to multiplying the area of their electrodes; and the difference between a gallon cell and a half-gallon cell is in the area of plates in action, and not in the E. M. F. Thus a relation between face-area of electrodes and the value of the current is apparent. And the question very naturally arises: Does there exist a definite relation between the volume of an electric current and the face-area of electrodes? To this problem electrical theory has as yet not given a precise solution. But electrolytic practice, on the other hand, such as is found in the trades of electrotypers and platers, has made a good practical solution of the problem. To these trades the question was of peculiar importance, because on its solution was dependent the quality of their manufactured goods.

It appears from trade experience, that in about the same way as electrolytic action is dependent on the application of a certain electric pressure in each special case, so not only does the quantity of deposit depend on the quantity of electric current applied, but the quality of the cathion also depends on an appropriate or properly proportioned relation between current and face-area of the electrodes. In the case of copper depositions from its sulphate, with a face area of one square metre of cathode for 250 ampères, the cathion shows the true physical qualities and especially the natural cohesiveness of the metalas, well as its natural color.

With this relation between face-value of cathode and number of ampères, solid plates of metal are produced as cathions, while with an area of cathodes that is in excess of 40 square centimetres per ampère, the deposited metal is brittle.

The relation between the face-value of cathode at the rate of one square decimetre and the ampère, when expressed by the thickness of deposit in a given time, is called electrolytic density (= ED).

The electrolytic hour-density for copper, according to Kohlrausch, is 0.001358. With an experimental value of 2.5 ampères per square decimetre of cathode, for obtaining a good quality of cathion and to obtain this thickness per hour, we must either reduce the face value of the cathodes per ampère to $\frac{1}{2.5}$ or $\frac{2}{5}$ of one square decimetre, or we must use a current of 2.5 ampères per square decimetre.

And as a special coefficient to this general value for electrolytic density the trades have established special values, analagous to the 2.5 for copper, relating to the different metals and classes of baths. The importance of the general value for electrolytic density, as well as of the experimental coefficient belonging to it, becomes evident at once, when the result is stated of varying these values in practical electrolytic operation.

In following up the illustration as derived from the deposition of copper, it may be stated that, if the area of cathode is proportionately smaller than two-fifths square decimetre per ampère, the metal has almost no cohesion of parts, and not only does it remain sandy, but it does not show the metal's natural color.

With an incorrect ratio between cathode-face and current silver appears yellow and gray, gold brown and even black, nickel dark gray, but with more cohesiveness than the other metals, copper dark brown and loamy. We can, therefore, obtain the metal by electrolysis either in a cohesive state or in crystalline or even sandy or loamy consistency. It is not claimed, that what electrotypers and platers find to answer their purpose mainly for copper deposition will answer either for the same metal, when deposited for other purposes, or for other metals, a special coefficient for electrolytic density being required, and to be experimentally established, for each special case.

Messrs. Siemens & Halske allow only 60 ampères per square metre of cathode for the precipitation of loose copper crystals on a large scale.

It then remains to show the values for electric and electrolytic densities. The nature of the first one of these values is properly expressed in the following equation:

$$(e.\ D.)\ \text{electric density} = \frac{C}{F} = \frac{\text{Ampères}}{\text{Face of electrodes.}}$$

* For interpretation of symbols compare the preceding list.

* Lord Rayleigh claimed another value yet of 0.010352 milligramme.

* Some superficial writers have made the attempt to controvert this fact by adducing the other fact, that from an identical reaction but for varying densities of electrolytes, the electric pressure (active or passive) varies. They have overlooked the influence of the electrolyte as a conductor by which a modification of such measured value of pressure is effected. Of this action of the electrolyte a later section of this series will treat.

And the second of these values is specified by the equation:

(*E.D.*) Electrolytic density)* $= \frac{A\,W\,P \times c\,P \times 0.000001}{2 \times c\,N \times \delta}$ mgm.

From the equation $Q = \frac{AWP}{2} \times \frac{c\,P}{c\,N} \times 0.00001$ gm. as the product of current unit, and from the one last quoted (ampère-second or coulomb), we can, as shown in the table, evolve the other electrolytic values for thickness of deposit per ampère-hour and decimetre square in the following easy method:

One gramme of water occupies one cubic centimetre of volume, and one gramme of copper occupies, on account of density = 8.8 (or 8.8 times greater weight than that of water in the same volume), only $\frac{1}{8.8}$ of one cubic centimetre: this is a thickness of $\frac{1}{8.8} = 0.113636$ centimetre on a face of one square centimetre.

And if 0.000316 gm. (the value *Q*) be spread over this one cm. square, then the thickness obtained would be as $0.000316 \times \frac{1}{8.8} = 0.00003591$.

And if this thickness of copper be again spread over a face (cathode) a hundred fold larger than the one centimetre-square, that is, on the face (cathode) of one decimetre square, then it would decrease to $0.00003591 \times 0.01 = 0.0000003591$ centimetre or to 0.000003591 millimetre thickness of copper.

An ampère may therefore even more precisely be defined as that quantity of electric current which will deposit from CuO per second 0.000316 gm. of copper, or which covers one square decimetre of cathode with a thickness of 0.000003591 millimetre of copper per second.

And by the equations:

Electrolytic density = (ninth column of table) $\begin{cases} \text{Electro-chemical equivalent.} \\ \hline \text{Metal density.} \\ \\ \frac{A\,W\,P}{2} \times \frac{c\,P}{c\,N} \times \frac{1}{\delta} \times 0.000001 \text{ mm.} \end{cases}$

I arrived at the values for electrolytic densities for given time units, of which the one relating to hour-ampère may here be quoted.

Electrolytic density, relating to hour ampère hour (10th column of table) = *E D* = thickness of deposit on one decimetre square per ampère-hour = $\begin{cases} 0.000001 \times 3{,}600 \times \frac{A\,W\,P}{2} \times \frac{c\,P}{c\,N} \times \frac{1}{\delta} \text{ mm.} \\ \\ \frac{0.0036}{2} \times \frac{A\,W\,P}{\delta} \times \frac{c\,P}{c\,N} \text{ mm.} \\ \\ 0.0018 \times \frac{A\,W\,P}{\delta} \times \frac{c\,P}{c\,N} \text{ mm.} \end{cases}$

Applied to the deposition of copper from CuO this value would read:

Hour-$E\,D = 0.0018 \times \frac{63.2}{8.8} = 0.01292727$ . . . millimetres,

as shown in the tenth column of the table.

It has then become apparent, that within the same current the electric density of such current may be proportionately increased, as the area of action be lessened, and may be lessened by increased face acted upon.

And we may speak of the same current (of *n* ampères) as having in given cases either dense or diffused action, according to the smaller or larger face it acts upon, or according to the lesser or greater thickness of metal deposited per ampère-second per square decimetre.

The results may then be expressed in general equations as follows:

Quantity of cathion per ampère-second (= *Q*) $= \begin{cases} \frac{A\,W\,P \times c\,P \times 0.00001}{2 \times c\,N} \text{ gm.} \\ \\ 0.000316 \text{ gm. of Cu.} \end{cases}$

or a

Thickness of cathion per 0.1²m. and ampère-second in mm. $= \frac{Q \times 0.01 \times 10}{\delta} = ED$ $= \begin{cases} \frac{AW\,P \times c\,P \times 0.000001}{2 \times c\,N \times \delta} \text{ mm.} \\ \\ \frac{0.1 \times 0.000316}{8.8} = 0.000003591 \text{mm.} \end{cases}$

Therefore the definition of the ampère may be varied by the general values or from the table inserted above by substituting the values relating to other metals and their respective compounds.

But it must be plainly understood, that these values for electrolytic density, etc., all relate to deposition from compounds analogous to the one in connection with which the ampère was originally measured, namely, SO_4Cu or expressed in conformity with electrolytic demonstration as $SO_3 + CuO$, which action again is analogous to the action on H_2O as well as on $(\frac{Cu}{2})_2 O$.

And all these equations lead to these inevitable conclusions, namely:

(14) With the proper condition as to electric pressure provided, as in each case required for electrolytically disuniting chemical compounds, the quantities of positive matter disengaged are proportionate in all cases to the chemical equivalent of such positive matter multiplied by $(\frac{1}{2} \times \frac{c\,P}{c\,N})$, half the quotient of the coefficient of the negative element in the coefficient of the positive element, this is to $\frac{A\,W\,P}{2} \times \frac{c\,P}{c\,N}$.

(15) The same electric current deposits of different metals quantities which are proportionate to one another as their atomic weights multiplied by half the quotient of the coefficient of the negative element in the coefficient of the positive element.

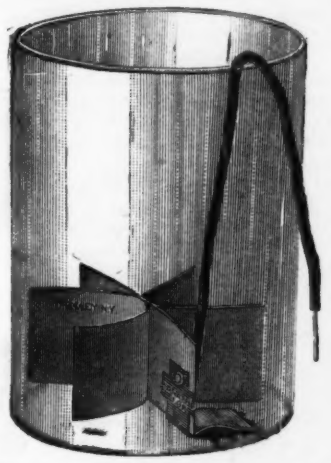
(16) The quantity electrolytically disengaged from any compound per ampère-second is as

$$Q = 0.00001 \times \frac{A\,W\,P}{2} \times \frac{c\,P}{c\,N} \text{ gms.}$$

* This value for electrolytic density (*E D*) should not be mistaken for the value: electric Density (*e D*), as in general use with electricians.

The Gravity Copper Anchor.

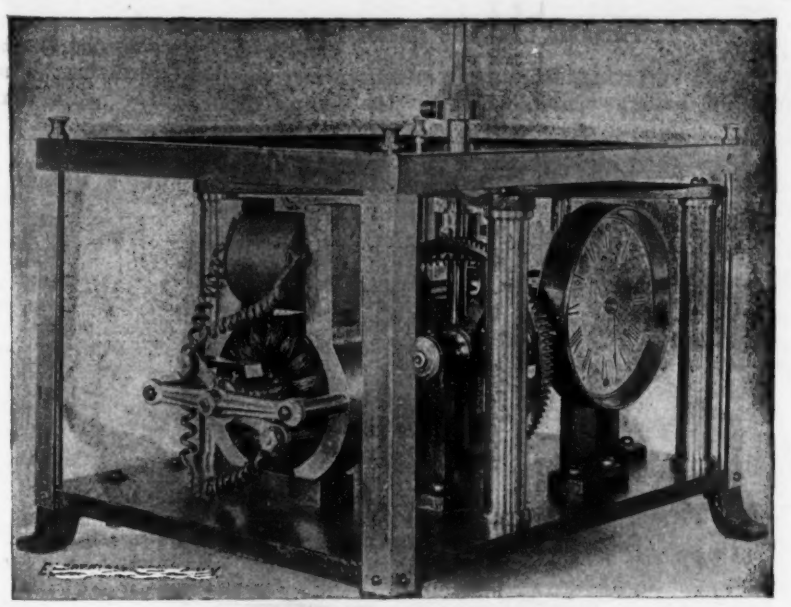
The accompanying illustration shows an improvement which has lately been made in the gravity battery copper,



ANCHOR FOR BATTERY COPPERS.

consisting of an anchor attachment for securely and permanently fastening or anchoring the copper to the bottom of the glass jar. The displacement of the copper electrode has always been a serious obstacle in the way of getting the best results from the popular gravity battery. This new device effectually prevents the copper from rising above the blue stone. The copper being held firmly on the bottom of the jar, a uniform distance is maintained between the two electrodes in all the cells of a battery, and consequently uniformity of resistance throughout and the highest efficiency obtained.

The anchor is made of a piece of sheet copper with a coat of adhesive compound or cement on one side, the upper end being riveted to the electrode, together with the copper connecting wire. When packed for shipping the anchor is rolled up in the shape of a cartridge, with the cement on the inside. To apply the anchor it is simply necessary to unroll the cartridge, bend it back at right angles parallel with the bottom of the jar, slightly heat the cement over the flame of a match or lamp, and the strip is then ready to be pressed down against the bottom of the jar in position. A little cold water is sufficient to chill and set the cement. Thus fastened the cohesion of the cement is sufficient to stand a strain on the wire equal to many times the weight of the jar. This new copper is now being placed on the market by The E. S. Greeley & Co., sole agents.



AN ELECTRIC TOWER CLOCK.

of the shaft, dispensing with outboard pillow blocks. As is well known, only a moderate sized fly-wheel is required with this type of engine, and for many uses, as where great regularity is not required, this may be dispensed with, the turning still being uniform enough for the purpose required. The working strains are also more equally distributed than with a single cylinder engine.

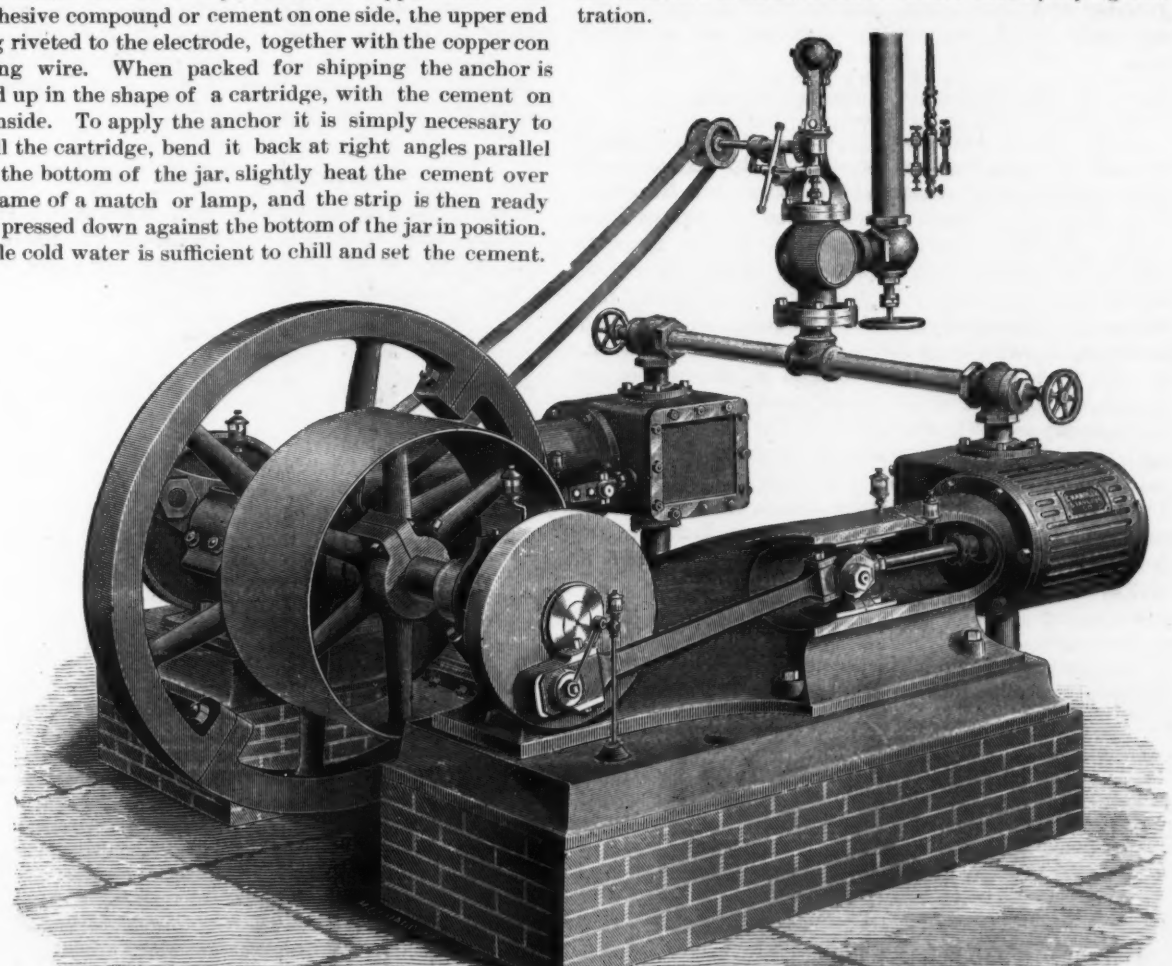
This engine, it is claimed, is so constructed as to admit of high rotative speed when desired, as in electric light plants, and for other purposes.

To render unnecessary the removal of the crank discs (which are both permanently fixed), the band-wheels and eccentrics are made in halves. This saves work and avoids the possibility of "throwing out" a crank in the operation of removing and replacing a disc.

The governor is placed at the centre of the connecting pipe, and there are valves for shutting off either engine without affecting the other. When desired, these engines are fitted with link motion.

Electric Tower Clock.

A new electric tower clock, which has recently been put on the market by the Standard Electric Time Company, of New Haven, Conn., and which is quite a departure from the usual tower clock, is shown in the accompanying illustration.



THE CHANDLER & TAYLOR TWIN ENGINE.

This clock is operated by an electric motor with suitable gearing, and arranged so as to be controlled by a self-winding regulator which starts the motor in operation once every minute. After the motor has carried the hands just one minute it breaks the circuit automatically, allowing the hands to rest at this point until the next minute is completed, when the same thing is repeated. The arrangement of the mechanism is so positive that there is no possibility of a variation from the correct time given by the master clock.

The ordinary tower clock is operated by weights, and the movement being exposed to the extremes of temperature cannot keep such good time as a clock that is finely adjusted and placed in a room where the temperature is more

New Twin Engine.

The engine illustrated herewith has been lately put on the market by the Chandler & Taylor Co., Indianapolis, Ind. The illustration shows an engine built for L. A. Thompson, which is to be used on the Switchback Railroad, to be operated in Jackson Park, Chicago, during the World's Fair.

The arrangement consists of two engines, a right and a left hand, coupled quartering, with crank discs on the ends,

uniform. Besides, the ordinary tower clock must be wound up every week, which requires the full strength of one man, while the electric tower clock never requires winding.

One of the important features of this clock is the operation of the motor by open circuit batteries. It has required a great many experiments by the company to arrange a motor in such a way that the battery would stand the work, and it is sufficient to say that from ten to fifteen cells of open circuit battery will drive the motor moving the hands to this clock for at least one year without any attention whatever. One of these tower clocks has been in operation during the past winter, and was not interrupted by any of the storms, while other tower clocks were motionless.

Portable Galvanic Battery.

The accompanying illustration represents a very portable form of battery manufactured by the Jerome Kidder Manufacturing Company, 820 Broadway, New York. The construction is seen from the cut. The zinc and carbon elements are securely attached to the cover or upper half of the case. The cells or compartments which hold the fluid are in a movable tray in the lower half. This tray is moved by the projecting bars, and when the battery is in use is raised so as to immerse the plates in the fluid, and is lowered again when the services of the battery are no longer required. The battery is provided with a current reverser and interrupter, and conducting cords. It is especially convenient for the physician and for family use.

PORTABLE GALVANIC BATTERY.

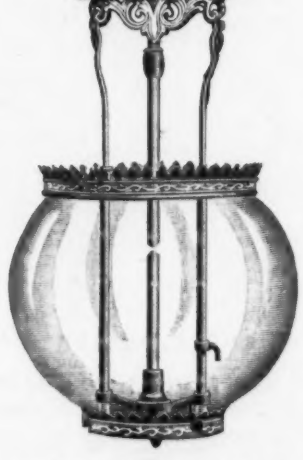
The McCreary Rheostat Switch.

A very simple and effective device for regulating incandescent lamps has been brought out by the McCreary Electrical Specialty Company, 136 Liberty street, New York, in the form of a rheostat switch, which is shown in the accompanying cut. This is a single pole switch about the size of an ordinary ten ampère snap switch. It is easily attached and can be put in any convenient place, from which the lights can be controlled in any way desired and turned up or down as readily as gas. It is claimed that the life of a lamp is greatly prolonged by the use of this switch, for the current is turned on gradually, whereas in the ordinary switch the whole current is turned on at once and the filament instantaneously heated. The switch is intended for either continuous or alternating currents and can be applied to motors as well as lamps. Rheostat switches for single 16 c. p. lamps for any voltage up to 115 volts are now manufactured and those for 2, 3, 4, 6 and 10 lights will soon be ready.

The Kester Arc Lamp.

The arc lamp shown in the accompanying cut is designed for constant potential circuits, and can be run on any incandescent light or 500-volt railway circuit. Two in series may be burned on any circuit of from 100 to 150 volts, and will maintain a steady arc with seven ampères of current or three and a half ampères per lamp, or four in series on a 220-volt circuit will consume seven ampères. This lamp has a positive clutch mechanism with a differential double stirrup, a single armature, a clutch-releasing device and lifting springs, mounted upon a single frame, and pivoted at one point. The clutch is a heavy block of bronzed metal, and has a positive grip. It cannot raise without carrying the carbon rod with it, which distinguishes it from most other lamps. All danger of the carbons dropping together is thus avoided, it is claimed. The insulation throughout is lava and porcelain. This lamp is manufactured by the Kester Arc Lamp and Manufacturing Company, 173 Canal street, Chicago.

RHEOSTAT SWITCH.

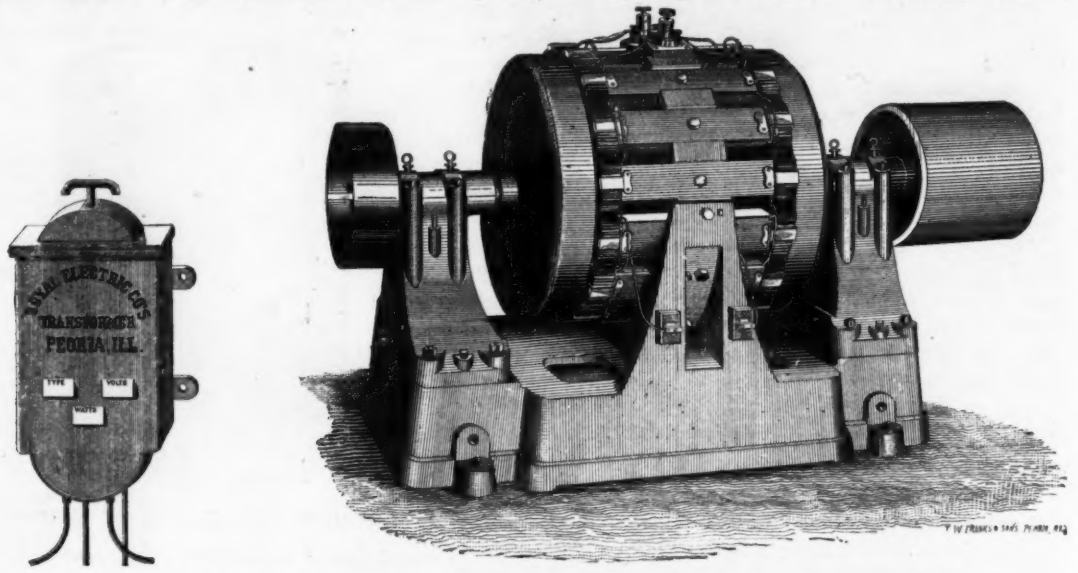


KESTER ARC LAMP.

The Royal Electric Company's Alternating Current Dynamo.

A novel form of alternating current dynamo is that which is shown in the accompanying illustration, and which is manufactured by the Royal Electric Company, of Peoria, Ill. The current is generated without revolving either the armature or the field magnets. The parts that do revolve with the shaft are the magnet core and the two disc-like pole pieces. Current is thus taken from the dynamo without the use of commutator rings or brushes, a method which has many advantages. A much safer insulation can be maintained, which is essential in machines generating a high electromotive force, and a burn out is practically impossible.

A shunt dynamo is used for the exciter, with carefully graduated resistance in its field circuit, so that the regulation is very close. It is claimed that the efficiency is very high, and that in a recent test a result of 14.7 16 c. p. incandescent lamps per horse power was obtained. The machines are thoroughly built, of first class material, with extra large self-oiling bearings.



ROYAL ELECTRIC COMPANY'S TRANSFORMER AND DYNAMO.

Electric Lighting in Paris.

The normal capacity of the central station in Paris is reported to be 17,500 h. p.; the maximum possible capacity is given as 32,000 h. p.; the total number of lamps is in the neighborhood of 175,000. In Paris there are said to be 85 000 houses, of which only 20,000 are lit with gas, consuming in the year 1891, 283,000,000 cubic metres of gas.

Application of Electricity in Making Tin Plates.

A patent has recently been issued to Mr. George H. Benjamin, of this city, for using an electric current in the manufacture of tin plates, for cleaning the sheet iron of dirt, grease and oxide of iron commonly found on the plates before they are tinned. The usual practice was to pickle the plates in a bath of sulphuric acid and water, and then rub them by hand with a cloth and sand to get rid of the dirt, grease and oxide of iron. This process was repeated until they were thoroughly cleaned, and was therefore naturally slow, tedious and expensive.

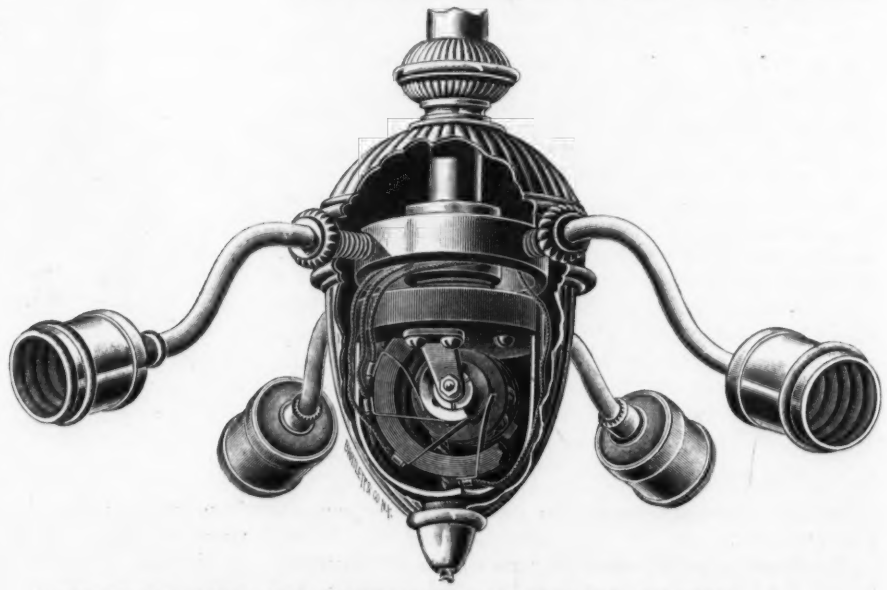
In the new method devised by Mr. Benjamin the plates are taken just as they come from the makers and are placed in a metallic cage, which is lowered into an electrolytic bath, such, for instance, as a solution of sulphate of soda, or sulphuric acid and water. This is connected to the negative pole of a dynamo while another suitable electrode of some resisting material is connected to the positive pole. The current passing through the electrolyte sets free hydrogen on the surface of the plate blanks, which reduces the oxides on their surfaces, and is said to decompose any grease that may be present, besides incidentally causing any accumulation of dust or dirt that may be on the blanks to drop off. The process is therefore very rapid and simple. Ordinarily it is sufficient to thus treat them in a solution of sulphuric acid and water for from 15 to 45 minutes, but when the plates are very greasy they may be immersed first in a solution of sulphate of soda, chloride of sodium, or any other solution of a neutral salt, the current being applied for about 15 minutes; subsequently to this they are electrically treated in sulphuric acid and water, as just described.

After thus cleaning the plates they are removed from the bath, rinsed with fresh water and dried by rapid heating, when they are ready for the tinning bath.

Interior Conduit and Insulation Company's Combination Chandelier Switch.

A new combination chandelier switch has been brought out by the Interior Conduit and Insulation Company, of New York. The accompanying cut represents a chandelier made for four lights only, but as many lights as may be required can be controlled by this device, which embodies the same principles as the Greenfield pull-down switches, also manufactured by this company. The mechanical arrangements of this new switch are very ingenious, and are contained in the shell or body of the chandelier. A pull on the cord turns on or off at will one or more lights consecutively, thus dispensing with switches on the side wall or key-sockets in the chandelier. No extra wiring for the switch and chandelier is required; each light is under direct control by simply pulling the cord, and the switch can be placed in the body of any chandelier, as it merely intersects the stem.

Such a device occupies but little room, ornaments rather than disfigures a chandelier, and saves so much time and trouble that it is fast coming into universal use. Its construction is so simple that there is little or no danger of its getting out of order.



INTERIOR CONDUIT COMPANY'S CHANDELIER SWITCH.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK AND BOSTON, July 16, 1892.

New York General Financial Market.—The week has been an intermittent one in Wall street. A number of exceedingly adverse conditions developed which would have been reflected in much lower values had there been a market of any moment. Owing to the extreme lethargy which has prevailed, values of almost all kinds were unresponsive, except in a slightly feverish manner. The threatened free silver legislation greatly terrorized English holders, causing a selling of American securities and consequent weakening tendencies in this market. The defeat of the bill later in the week, re-established confidence on the other side, which will be apt to be felt on the bull side of this market next week. The Anti-Option bill is another measure which has hung like an ominous cloud over the street, causing an almost total suspension of operations in futures on the produce exchanges. It is placed at the bottom of the Senate calendar from which it can be taken out of turn only by a two-thirds vote. Some of its opponents are holding back a trump card in the form of an amendment to include flour in its provisions. Should this amendment pass the Senate it would surely meet with the opposition of flouring interests in the House, where it would have to go for a concurrence. The Homestead and Cœur d'Alene strikes, and the unsettled condition which they created in the labor world, have shaken the confidence of investors, both in this country and in Europe, and serve to further contribute to the dull market. The close of another week will see all of these measures disposed of, and in all probability an adjournment of Congress. There are many brokers who are prophesying a bull market in the industrial stocks immediately after Congress adjourns. They base their belief upon the bearish tendency of legislative proceedings during the entire session, most of which were calculated for political capital. The result has been to depress values in all the trust stocks to that degree which has placed them to-day proportionately below the values of the various railroad situations. The exports of gold this week aggregated only $750,000, a most satisfactory showing. The money market is either easy, steady or firm at all points in this country. In the central West it is reported steady. New York's exchange is at a par in Eastern and Middle States; 10 per cent. premium at Chicago. Money on call is from 1½ to 2 per cent. Time loans have not changed since our last report.

New York Electrical Stock Review.—Conditions mentioned preceding have had a bearing upon most of the stocks in the attached list. However, they vary from the railroad and other industrial securities in being firm as to values, and in some cases show a slight advance. General Electric from a very weak closing last week, owing to the pressure of a large block of stock, regained the ground lost, and developed exceptional activity at the closing, 1,720 shares being brought out and an advance of 2⅝ points scored, the closing being 111½ and very firm. Edison Electric Illuminating had a comparatively active week on investment buying. This advanced the price from 85¾ to 88½ at the closing. Two lots aggregating 8,000 shares of first mortgage bonds sold at 102, a slight advance of previous sales. North American was traded in at job lots during the week ranging around 13 and a fraction. A sale of Westinghouse E. & M. assenting certificates, the first in several weeks, was made at 53½ on Friday. Commercial Cable was gradually hardened as to holdings and at one time during the middle of the week was bid 157. It was held to-day at 160. No sales are recorded. There were minor transactions in some of the other stocks, as shown in the quotations below. French Cable's books, according to an Associated Press dispatch, show a very unsatisfactory condition of the company, there being a marked decrease in earnings and an increase in expenses.

Financial Matters in Boston.—It requires a pretty strong influence to materially affect the conditions of the market at this season of the year, and even the strongest is liable to prove only temporary in the face of much that tends to counteract it. The single item of strength this week has been the favorable action on the silver question, and no review of the market can omit a mention of this, for it has inspired the Eastern markets, which must always support the Western; and the influence in London is very apparent. Labor troubles have been urged against European buying of our securities, but the weakness and shortlived unity of the forces have already so often been seen in similar outbreaks that at best the bears have a very weak argument in predicting a widespread crisis. The surety of crops and all the conditions affecting Western roads are indisputable, and in consequence thereof prices are generally strong, and promising even better. Speculation has been rather light in volume. Sentiment is all bullish, and, though it materializes very slowly, still the talk of the street has favored an active and rising market. Rates are about the same, and there is no probability of any material change. The supply of funds is large, exceeding the demand. The comptroller's call kept money a little tighter for a while, but now that necessity is removed and the banks will let go a little of the surplus that they hung to so tenaciously until their report should be made up. Business paper brings 3 to 5 per cent.; collateral loans 4 to 4½ per cent., and call loans 4 to 5 per cent.

Electrical Stocks in Boston.—The Boston traders are trying to persuade themselves that a boom is about due on electrics, and they are keeping the prices very firm, with an upward tendency. There is little or no news pro or con regarding the various stocks, but one prevailing tone, and that is a strong one. The Thomson-Houston stockholders have an extra dividend of 20 cents August 1, which was promised some time ago out of the company's surplus, before the stock should be exchanged for general stock. It has been discounted, however, and the price does not reflect it in any measure. The General Electric bonds met with as favorable a reception from the public as the stock has, for the $4,000,000 which was offered was over-subscribed 20 per cent. The stock has remained strong during the week, with very little offering and a good demand. The trust companies are requesting more prompt transfers of the Thomson-Houston and Edison stocks since the first preferred dividend on the general stock is now payable. The Northwest Thomson-Houston dividend checks bear the new name of the company—the Northwest General Electric Company—showing that the transfer was completed at the recent meeting of the stockholders. Only one sale of Westinghouse common has been noted during the entire week, and that was at 27. Small sales of the preferred have been made at prices slightly below the best. A movement is on foot to resuscitate the affairs of the European Welding Company and gain if possible something tangible as to its real status and prospects. The governing board of the Stock Exchange on Friday admitted to the regular list General Electric stock. It has already been traded in, but this is its official entrance to the Exchange. Thomson-Houston will therefore soon disappear entirely.

Western Union.—There has been heavy buying in Western Union during the last two or three weeks from parties who are known to be insiders. Before the declaration of a dividend they gave as their reason for thus laying in stock that they believed the dividend would be increased. Now that it has been declared, no showing an increase, they are silent upon their past and present operations. They continue to buy, however, and their object is still beneath the surface. It is very quietly whispered that there is a deal of gigantic proportions now going on, looking toward the absorption of certain prominent competitors; we do not vouch for this but give it for what it is worth.

Increase in Capital Stock.—The Northwest Thomson-Houston Electric Company has changed its title to the Northwest General Electric Company and increased its capital stock. The capital stock is $1,750,000, of which $1,000,000 is common stock and $750,000 preferred. Dividends on the preferred stock are not to exceed eight per cent. per annum. The stock is in $100 shares. The Hartford (Conn.) Light and Power Company has certified to an increase in capital stock from $125,000 to $150,000.

Dividends.—The General Electric Company has declared a dividend of 2 per cent. on the common capital stock of the company, payable August 1 to holders of common stock of record on June 20. The Edison General Electric Company has declared an eleventh quarterly dividend of 2 per cent. on all the stock of the company, payable August 1, to holders of record July 20. The Uxbridge Mass., and Northbridge Electric Company has declared a semi-annual dividend of 2 per cent. payable August 9, on all stock of record June 30. All the stock issued by the company has been subscribed for. The Edison Electric Illuminating Company, of New York, has declared a quarterly dividend of 1¼ per cent. payable August 1. The Crocker-Wheeler Electric Company, New York, has been in operation a little over two years. Last winter they paid a dividend of 5 per cent. We have just learned that they paid an extra dividend of 3 per cent. July 1, out of the earnings of the company. Their business has increased so rapidly that they were compelled last year to increase their capital stock from $100,000 to $200,000. The new stock was quickly sold for cash at par, all being taken by some of the strongest men in the city, whose names would be familiar to our readers. The officers of the company are: President, S. S. Wheeler; vice-president, F. B. Crocker; secretary and treasurer, D. H. Jeffery. The business this year, it is stated, has averaged several times as much as last year, and, notwithstanding the largely increased plant, the company has been compelled to run nights to keep up with its orders. The Thomson-Houston Electric Company has declared a dividend of $1.20 per share on the common capital stock of the company, payable Aug. 1 to holders of record June 20. This has been done, it is stated, to even up the returns to stockholders upon the basis of the consolidation with the Edison General Electric Company. A dividend of $3 per share and an extra dividend of $3 per share was payable July 15 by the American Bell Telephone Company. A quarterly dividend of 2 per cent. on the common stock was payable July 15 by the Northwest Thomson-Houston Electric Company.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, July 16, 1892, in New York, Boston and Chicago:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American Bell Tel	100	17,500,000	....	....	....	..
American District Tel	100	3,825,000	59	60	60	64
American Tel. & Cable	100	14,000,000	....	86	85	87
Central & So. Am. Tel	100	6,000,000	....	....	.	.
Commercial Cables	100	7,716,000	....	....	154	160
Debentures	...	1,000,000	....	....	....	..
Erie Tel. & Telp	100	4,800,000	....	....	.	..
Gold Stock & Tel	100	5,000,000	..	....	100	103
Bonds	500	500,000	....	....	100	..
Mexican Tel	100	2,000,000	....	....	....	..
Northwestern Tel	50	2,500,000	....	....	....	..
First Mort. Sinking Fund	500	1,180,000	....	....	....	..
Postal Tel. & Cable	..	10,000,000	....	....	62	64
Southern & Atlantic Tel	25	948,775	....	....	78	84
Western Union Tel	100	15,000,000	93	93⅜	92¾	93¼
Real estate bonds	1,000	1,219,000	....	....	....	..
Debenture bonds	1,000	4,920,000	....	....	....	..
" sinking fund bonds	500	841,266	....	....	....	..
Collateral Trust 5's	1,0 0	8,181,000	104	104½	....	.
North American	100	39,767,200	13⅜	13⅞	....	....
Brush Ill. Co. of N. Y	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y., ex-right	100	6,500,000	85¾	88½	85¼	86
Edison El. Il. of Brooklyn	100	750,000	....	....	85	90
" " " " Chicago	100	750,000	....	....	130	145
" " " " Boston	...	.....	....	....	115	125
Edison El. Lt. Europe	1,000	2,000,000	....	....	2	6
" Bonds	...	30,000	....	....	65	80
Edison Ore Milling Co	...	2,000,000	....	....	15	20
East River El Light	100	1,000,000	....	....	....	65
General Electric	1,000	50,000,000	107½	108¾	108¼	109
Automatic Exhibition Co.	...	2,500,000	....	....	3	5
Mt. Morris Electric	...	500,000	....	....	....	65
N. E. Phonograph	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
North American Phonograph	...	2,000,000	....	....	4	6
Westinghouse Elec & Mfg. Co. 1st p. 7 per cent. Cum.	50	3,717,253	....	....	....	....
E. & M. Co. Assg	50	5,038,116	53½	....	....	..

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec	25	6,000,000	65	64	65	65¼
Thomson Houston Elec. preferred	25	4,000,000	30	29	29½	29¾
Thomson-Houston Elec.—Series C	sh	40,000	....	....	8½	9
Thomson-Houston Elec.—Series D	sh	120,000	7¼	7⅛	7¼	7⅜
Thomson-Houston Int'n'al Elec	100	600,000	....	....	250	260
Thomson-Houston Int'n'al Elec—Pfd	100	400,000	....	....	103	106
Thomson Elec. Weld	100	1,000,000	....	....	....	....
Thomson European Elec. Weld	100	1,500,000	10	....	10	12
Westinghouse Elec.—New Com.	..	6,000,000	....	....	27	28
Westinghouse Elec.—Pfd.	..	4,000,000	45	42½	44	45
General Electric	..	30,067,200	108½	107	108½	109
" " Pfd	...	4,136,300	120	117	119	120
Fort Wayne Elec	25	4,000,000	12¾	12½	12⅛	12⅝
FortWayne Elec.—Ser. A.	sh	80,000	7½	....	7¼	7⅛
Detroit Elec	10	1,000,000	7⅛	7	....	....
West End St. Ry. Co.—Com	50	7,150,000	72⅝	71¾	72¼	72⅛
West End St. Ry. Co.—Pfd	50	6,400,000	88	87⅞	87¾	88
American Bell Tel	100	15,000,000	204	203	203½	204
Erie Tel. & Tel. Co	..	4,800,000	47⅛	44¾	46	46⅛
Mexican Tel. Co	10	1,280,000	1.03⅛	....	1.02½	1 10
New Eng. Tel. & Tel. Co.	..	10,304,600	56	55⅛	....	56
Tropical Tel. Co	10	400,000	20	....	....	20

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.
Chicago	223	..
Ex-dividend.		
Central Union	56	58
Bell of Missouri	182	185
Iowa Union	20	25
Ex-dividend.		
Michigan	88½	91
Missouri & Kansas	58	65

Electrical Stocks:	Bid.	Ask'd.
Chicago Arc Light & Power Co	92½	94
Chicago Edison Co.	165	..

The Copper Market.—The copper market shows a further decline in values of lake copper, several round lots having sold at figures ranging between 11¼ to 11.4. This is as we prophesied last week, and we will make the further prediction that values will not rally before our next report. Yesterday European and American interest held meetings in their respective countries for the purpose of canvassing trade conditions and arriving at an understanding calculated to better the market. It is reported upon fairly good authority that the attempts to form a combination which only recently fizzled, are to be revived, and that the one great object which consisted in an attempt to arrive at an understanding among themselves without calling in the assistance of disinterested third parties, will be surmounted by the employment of a professional syndicate former, who will act as a go-between, obtaining from each of the interests to the combination necessary data concerning their resources and operations which they would not give under the old plan for fear of informing their competitors as to the inside details of their business. Exports this week were 1,233,000 pounds of matte. As was the case last week no fine copper was sent out.

NEW INCORPORATIONS.

The Platt Electric Company, Decatur, Ill.; capital stock, $100,000; incorporators, J. H. Culver, Elmer E. Gibson and Richard F. Platt.

The Beacon Electric Company, Chicago, Ill; capital stock, $30,000; incorporators, W. Clyde Jones, George W. McMahon and George L. Cragg.

The Morse Light, Heat and Power Supply Company, Chicago, Ill., capital stock, $1,000,000; incorporators, George L. Cragg, George W. McMahon and Louis Spohn.

The Kimball Underground Electrical Company, Chicago, Ill., capital stock $1,000,000; incorporators, Daniel E. Kimball, David L. Clymer and Lawrence Peterson.

The Marlin Oil Company, of Marlin, Tex., capital stock $100 000, has been formed to supply electricity for light, heat and power. M. Levy, T. E. Bante, T. A. Cheeves and J. W. Robinson are the incorporators.

The Elwood Electric Railway Company, of Elwood, Ind., capital stock $150,000, has been formed to erect electric railways, etc. Aretus W. Hatch, Willard C. Nichols and Andrew T. Hart are the incorporators.

The Sharon Hill Electrtc Company, of Sharon Hill, Pa., capital stock $1,000, has been formed to supply light, heat and power by electricity to that town. Robert Barry, Thomas Garvin and John Muldoon are the promoters.

The Security Insulator Company, of Elizabeth, N. J., capital stock $10,000, has been formed to manufacture electrical supplies and sell the same. F. L. Pope, G. C. Brown and A. S. Brown, of Elizabeth, N. J., are the incorporators.

The Manchester Road Electric Railway Company, of St. Louis, Mo., capital stock $20,000, has been formed to own and operate an electric railway. T. Howard, M. C. Orton and J. Daniels, of St. Louis, are the promoters.

The Knapp, Sellner Chandelier Company, of St. Louis, Mo., capital stock $20.000, has been formed to manufacture and sell gas and electric light fixtures, etc. A. J. Knapp, H. A. Sellner and A. G. Sellner, all of St. Louis, are the promoters.

The Tiffin Electric Street Railway Company, of Tiffin, O., capital stock $50,000, has been organized to construct and operate electric street railways. M. Frost, Frank Bloom, W. F. Noble, R. D. Sneath and John L. Lott are the incorporators.

The Standard Electric Light and Power Company, of North Tonawanda, N. Y., capital stock $100,000, has been formed to produce electricity for light, heat and power. Geo. P. Smith, John D. Warren and Susan O. Smith are the incorporators.

The Newport Electric Light Company, of Newport, N. H., capital stock $15,000, has been formed to furnish electric lights. Seth M. Richards, Wm. T. Richards, Martin L. Whitteier, Arthur B. Chase and Myron W. Tenney are the incorporators.

The Automatic and Electric Scale Company, of Jersey City, N. J., capital stock $200,000, has been formed to manufacture and sell scales, etc. H. M. Cross, Boston, Mass., M. Marx, Brooklyn, N. Y., and J. Griffin, Jersey City, are the promoters.

The People's Electric Light and Power Company, of Evansville, Ind., capital stock $100,000, has been formed to generate electricity for heat, light and power. R. T. McDonald, H. J. Miller and Brainard Rorison, of Fort Wayne, Ind., are the promoters.

The Fayette Real Estate and Investment Company, of Boise City, Idaho, capital stock $25,000, has been formed to erect an electric light plant, etc., etc. The promoters are R. D. Woolterbeck, W. S. Bruce, B. M. Boggs, B. W. Walker and P. C. Lellman.

The Cedartown Company, of Roanoke, Va., capital stock $750,000, has been formed to erect electric light plants, etc., etc. Dan Baugh, Philadelphia, Pa, J. W. Adamson, Cedartown; E. M. Weston, R. R. Carson and N. B. Crenshaw, are the organizers.

The Kalispell Water and Electric Company, of Kalispell, Mont., stock $250,000, has been formed to deal in electricity for lighting, heating and other purposes, etc. Jos. A. Cotan, F. E. Corbett and John B. Wellcome, of Kalispell, Mont., are the incorporators.

The Webb City Light and Power Company, of Webb City, Mo, capital stock $150,000, has been formed to manufacture and supply electric light and power. W. G. Maybury, Detroit, Mich., T. H. West, J. T. Davis, both of St. Louis, Mo., are the incorporators.

The Compound Electric Motor and Dynamo Company, of Chicago, Ill., capital stock $500,000, has been formed to manufacture and sell electric motors and dynamos, etc. Charles Turner Brown, Archibald J. Robertson and Fred. E. Turner are the incorporators.

The Point Sewell Hotel Company, of Norfolk, Va. capital stock $300,000, has been organized to erect electric light works, etc. The promoters are D. Lowenberg, J. W. Perry, Norfolk, Va.; W. E. Clark, Washington, D C.; N. Newton, J. T. Allyn and B. Myers.

The Berlin Electric Light Company, of Portland, Me., capital stock $50,000, has been formed to generate and distribute electricity for light, heat and power. Henry H. Furbush, W. H. Furbush, Berlin, N. H., Harry R. Virgin, and Fred S. Hall, of Portland, Me., are those interested.

The Municipal Improvement and Investment Corporation, of New York, capital stock $500,000, has been formed to acquire by purchase, lease or otherwise, street railways, electric light plants, etc. H. A. Holt, P. S. Swain and J. R. Turner, all of New York, are the promoters.

The Everett and Lake Stevens Water and Electric Company, of Everett, Wash., capital stock $250,000, has been formed to operate and maintain water works, electric light and power plants, electric railways, etc. J. J. Falstad and George S. Brown, of Everett, are the promoters.

The Union Electric Company, of Benton Harbor, Mich., capital stock $150,000, has been incorporated to furnish electric light and power and to erect a street railway. This is a consolidation of

the Union Street Railway Company and the People's Electric Light and Power Company under the above name.

The Chillicothe Electric Railway and Lighting Company, of Chillicothe, O., capital stock $100,000, has been formed to build and operate an electric street railway, and to furnish light and power. Wm. Poland, C. W. Story, J. A. Nipgen, M. Cahill and R. Ederlin, are the incorporators.

The Home Electrical Concern of Brooklyn (incorporated in West Virginia), of Brooklyn, N. Y., capital stock $100,000, has been formed to manufacture, sell or lease all kinds of electrical devices, etc. Winthrop Pond, Frank Daniels and Henry C. Baldwin, of New York City, are the incorporators.

The United States Wire and Cable Company, of Schenectady, N. Y., capital stock $1,000,000, has been formed to manufacture and sell wire, wire rope, cable, conductors, etc.; and every kind of wire used in connection with electrical apparatus. B. F. Sunny, Chicago, Ill., Silas A. Barton, Boston, Mass., and Samuel Insull, of Chicago, are the incorporators.

The Ceramic City Light Company, of Newark, N. J., capital stock $50,000, has been formed to transmit electricity for light, heat and power. R. Arter, New Lisbon, O.; G. T. Harbaugh, S E. Harbaugh, Sewickley, Pa ; C. M. McKeehan, W. H. Murphy, East Liverpool, O.; P. M. Smith, A. R. Wells, Wellsville, O.; and W. F. Zimmerman, of Newark, N. J., are the incorporators.

The County Club, of Seattle, Wash., capital stock $24,000, has been formed to construct and operate electric railways, telegraph and and telephone lines, electric light plants, etc. Among the promoters are R. B. Albertson, W. E. Baily, H. Chapin, G. E. Carter, J. Collins, E. B. Downing, J. R. Galt, G. H. Heilbron, L. S. J. Hunt, W. A. Peters, B. Pelly, G. H. Preston and R. C. Washburn, of Seattle, Wash.

Albany, N. Y.—A certificate of the consolidation of the Thomson-Houston Light, Heat and Power Company with the Binghamton Electric Company, forming the Binghamton General Electric Company, has been filed. The new corporation has a capital of $400,000, and will furnish electricity in Binghamton and in the towns of Union and Dickinson. The directors are George W. Dunn, James E. Shapleigh and James H. Roberts, of Binghamton; John Waist, of Cooperstown; Frank Gould, of Oneonta, and Robert E. Drake and Paul T. Brady, of Syracuse.

AFFAIRS OF THE COMPANIES.

Reynolds, Spaulding & Co. is the name of a new company which has established itself in Hartford, Conn. Its work will be in the line of electrical engineering and construction.

The American Union Telegraph Company at its annual meeting elected the following officers: Thomas T. Eckert, president; Charles A. Tinker, vice-president; Thomas F. Clarke, secretary and treasurer. The directors are Thomas T. Eckert, A. R. Brewer, F. B. Bertholf, Charles A. Tinker and Thomas F. Clarke.

The Wellford Telephone Company has obtained a commission for a charter. The corporators named are J. R. Snoddy, J. Wesley Jones, Thos. E. Moore and J. Z. P. Horan. The capital stock of the company is only to be $300, divided into shares of $1 each. The company proposes to run and operate a telephone line between Wellford and Spartanburg.

Chicago, Ill.—The directors of the new incorporation for constructing an electric railway between Elgin and Aurora have elected the following officers: William Grots, president; John M. Egan, vice-president; Henry A. Gardner, secretary; Henry H. Evans' treasurer; Arthur M. Beaupre, auditor; T. E. Ryan, general solicitor. The board transacted considerable business. Books of subscription to the capital stock were opened and steps taken to obtain the right of way as speedily as possible. An examination of the proposed line is to be made by the directors in a few days.

The Canadian Niagara Power Company, to develop the power of the Horseshoe Falls, in Victoria Park, was formally organized at Niagara Falls on Saturday last at a meeting held at the Clifton House. There were present Col. Albert B. Shaw, Francis L. Stetson, and William D. Rankine of New York, and John D. Irwin, John G. Scott and C. J. Elliott of Toronto. These officers were elected: President, Col. A. D. Shaw; vice-president, F. L. Stetson; secretary and treasurer, W. D. Rankine. The lease of the exclusive privileges to develop the power of the falls in Victoria Park, which was granted to Messrs. Shaw, Stetson and Rankine by the Park Commissioners, was duly transferred to the newly organized company. Colonel Shaw is reported to have said that they will await the completion of the tunnel on the American side before commencing operations in Canada.

The Hall Signal Company has acquired a controlling interest in the Johnson Railroad Signal Company, and hereafter the business of the two companies will be carried along together. The two organizations will remain distinct, but each company will take orders and solicit business for the other. The mechanical, as distinguished from the electrical, work of the Hall company will hereafter be done at the Johnson shops. The Johnson Railroad Signal Company has elected the following officers: President and general manager, Charles R. Johnson; vice-president, William P. Hall; treasurer and assistant general manager, Henry Johnson. Mr. H. M. Sperry remains as general agent of the Johnson company. It is the intention to increase largely the working capital of the Johnson company to handle its increasing business. In the last half year the Hall company has taken contracts to the value of over $500,000 and the Johnson company of over $200,000. The consolidated concerns will now control the Sykes system and the Bezer "Lock and Block" system, and will be prepared therefore to do manual block signaling work of the most advanced character. The New York office of the Johnson company remains for the present at 47 Broadway, and that of the Hall company at 50 Broadway.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, July 18, 1892.

Mr. J. D. Leisenring, of F. Reddaway & Sons, 52 New street, left last week on an extended trip as far East as Bangor, Me.

Invitations have been sent out for the Fourteenth Annual Rhode Island Clam Dinner, which is tendered to the electrical fraternity by the American Electrical Works of Providence, R. I. It is to be held on Saturday, July 23, at Haute Rieve, the Union Club country house.

The New York Electrical Society at its annual meeting on July 14 elected the following officers: Joseph Wetzler, president; F. B. Crocker, J. J. Carty, Nikola Tesla, Chas. Cuttriss, T. R. Tallavale, R. S. Dobbie, vice-presidents; Geo. H. Guy, secretary; N. A Sinclair, treasurer. The society now has 292 members, an increase of 28 members over last year.

The Magnetic Club will hold its mid-summer meeting on Wednesday, July 27, in the form of an excursion and dinner at Donnelly's Pavilion, College Point, L. I. The steamer "Western Union" will leave Pier No. 20 N. R., foot of Dey street, at 3:15 P. M. to carry such as may be able to leave at that hour direct to the hotel dock. Others can avail themselves of the regular College Point boats, which leave the foot of East Ninety-ninth street at frequent intervals. L. H. H.

Albany, July 16, 1892.

The Electric Road at Fonda has purchased the rink of A. A. Burch for a depot, the price being $4,500.

Big Receipts.—The fares of the Union Electric Railway, of Saratoga, are averaging $500 a day this season of the year.

A Member of the West Side Street Railway Company of Elmira states that the work upon the road will be begun immediately.

The Village Officers of Hoosic Falls has ordered certain electric lights to be removed as nuisances because of the large number of insects that they attract.

The Directors of the Cayadutta Electric Railroad, of Johnstown, have voted to increase the capital stock from $120,000 to $350,000. The work on the road will be commenced in about two weeks. Property has been purchased at Fonda for a car shop and station.

Free Messages to St. John, N. B.—The Western Union Telegraph Company has authorized its managers to accept for free transmission over the lines all messages in relation to the relief of the sufferers from the fire at St. John, N. B., not including, however, money transfer messages.

A Long Distance Metallic Telephone Service has been constructed between this city and Newburgh. William H. Cull, chief electrician of the Hudson River Telephone Company, is superintending the work and that of introducing the Western Electric system in the central office at Kingston.

The Difficulty between the city authorities of Gloversville and the Johnstown, Gloversville & Kingsboro Railroad Company has assumed a new phase. Justice Kennedy, of Syracuse, has disolved the injunction granted by Justice Stover, restraining the railroad company from laying their tracks in the side of the highway, and a gang of workmen are now at work relaying the tracks where they formerly were. The change is being made for an electric railroad. Further complications are anticipated.

An Electric Sprinkler.—The latest application of electricity in Albany is as the motive power for a street sprinkler. The car, which was built by the United Tramway Sprinkler Company, o Louisville, Ky., is running on the Albany railway. The electrical apparatus for moving the car is the same as is used in operating passenger cars. The car is capable of holding 2,000 gallons of water and is mounted on wheels three feet high. The water is sprinkled by means of perforated pipes placed under the platforms and a pipe arm, also perforated, which may be carried alongside of the car or at right angles to the side of the car. R. V. T.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., July 16, 1892.

A. D. Adams, of the Jenney Electric Motor Company, 218 to 224 So. Illinois street, Indianapolis, while in town this week, made a pleasant call at the office of The Electrical World.

The Holyoke (Mass.) Machine Company has placed an electric motor in its new building which is to be used as a roll department. The company also lights its own buildings by electricity.

Milford, Conn.—The Milford & Hopedale Street Railway Company has leased part of the Johnson & Rust factory, and will soon commence the manufacture of storage batteries and other electrical supplies.

R. M. Jones, Salt Lake City, Utah, contractor for complete electric railways, steam power plants, electrical transmission of power, and electric lighting, made a pleasant call at this office this week.

The contracts for the new electric plant, including engines, dynamos and wiring for the State House extension will not be awarded until next week, or possibly later, on account of the diversity in the figuring of those who put in proposals yesterday, conditional and otherwise. Engineer Webster, of the Massachusetts Electrical Engineering Company, has been requested by the commission to make an examination of the proposals and report to the commission.

Railroad Hearings in Wakefield.—At Wakefield a hearing was given this week on a petition of the Wakefield & Stoneham Street Railway Company, for permission to lay tracks on Main street to Melrose Highlands, and on Water street to Cliftondale, the idea being to connect with the East Middlesex road at Melrose Highlands and the Lynn & Saugus road at Cliftondale. After a general discussion the hearings adjourned and the selectmen voted to grant a charter.

President J. B. Haggin, of the Anaconda Mining Company, has decided to have the entire output of his mine refined in America instead of Europe, and it has been arranged to have the product of the mine undergo the electrolytic treatment at Baltimore. Contracts have been awarded for the enlargement of the works here and the doubling of the Baltimore Electric Company s plant. When these improvements are completed, probably by the middle of September, the works will be able to treat over 4,000,000 pounds of copper ore monthly.

Electrical Fountain.—The special committee from the Lynn city government, on the construction of an electrical fountain, held a meeting at City Hall, Wednesday evening. The city engineer was present, as was also John A. Heinze, the electrical expert, who has submitted plans for the fountain. The cost of the construction will be about $2,000, and the maintenance will be but little over $50 per year. Under the provisions of the bequest of the late William Shute, who gave $2,500 for the purpose, the fountain is to be located either on the common or the City Hall grounds. The plans submitted embrace one of the most ornamental structures of its kind ever erected in this country.

Test of Bradbury-Stone Storage Batteries.—An interesting test was recently made at Dover, N. H., of the Bradbury-Stone storage batteries. A point was selected on the electric street railway where the grade was 10 per cent., and in a building by the roadside were placed 260 cells of the type 11x, weighing about 12,000 pounds. These batteries were connected to the trolley on the grade and worked this portion of the line independently. The test was made with two 14-seat cars equipped with Robinson radial trucks and two 15 h. p. Thomson-Houston motors. The two cars were coupled together, loaded and brought to the foot of the hill into contact with the battery circuit. They were taken up the grade with perfect ease. Instruments showed that 100 h. p. was developed. The batteries were carefully watched, but there were no signs of buckling or even boiling. This system has been in operation since July 4 and has proven entirely successful, it is claimed. The idea is to have storage batteries placed at every important hill or grade, which can take the cars up and relieve the power station of this extra load. It is thus seen that the station would only have to furnish power for a comparatively level road. W. R. W.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, July 16, 1892.

Mr. James R. Dee, of Houghton, Mich., enjoyed a visit to the World's Fair Grounds on Sunday.

Mr. C. E. Gregory, of Chicago, had the pleasure of closing three contracts for electric light apparatus last week.

The Electric Machine Company, No. 1008 Title and Trust Building, Chicago, is placing a new cutting machine on the market.

Captain John McKinlock, treasurer of the Western Electrical Supply Company, the Omaha branch of the Central Electric Company, is in the city for a few days.

Mr. George Cutter returned to Chicago from his flying trip East, where he was the recipient of many congratulations over the success he has met with in one of his recent extensive deals.

The Sunbeam Incandescent Lamp Company, Chicago, is in receipt of some large renewal orders, with accompanying letters speaking in high terms of the efficiency and length of life of the Sunbeam Lamp.

The Electric Appliance Company reports success with Paranite wire, having received very large orders from St. Louis, Milwaukee and St. Paul within the last few weeks, in addition to its regular business which has been exceedingly large.

Mr. J. A. Hanna, who for the past eight years has been with the J. G. Brill Car Company, of Philadelphia, has accepted a position as general traveling salesman with the McGuire Manufacturing Company, of Chicago, and will hereafter represent that firm.

The McGuire Manufacturing Company has closed among recent large contracts the following: South Chicago City Railway Company, Kankakee Electric Railway Company, Toledo Consolidated Street Railway Company and Pueblo City Railway Company.

Delay of Foreign Governments.—Chief of Construction Burnham reports that foreign governments are seriously delaying the construction of some of the buildings. Out of the fifteen countries that have been allotted space for a building but three have forwarded plans.

The Westinghouse Company has begun work on its contract for furnishing the incandescent lights for the World's Fair by placing lamps in the Woman's Building. The designs for the arc light posts which will be erected throughout the grounds to the number of about 1,000 have been completed. One-third of the material for the electric light plant is already on the grounds.

Mr. Geo. E. Gisher, manager of the Commercial Electric Company of Detroit, has been appointed chief of the electrical division of the Detroit Exposition in 1892. The buildings and grounds occupy 72 acres and the Exposition opens Aug. 23 and closes Sept. 2. The Commercial Electric Company has the contract for the electric lighting, which will require 300 arcs and 1,000 incandescents.

The Chicago & Northwestern Railway has placed orders for the equipment of it [new electric light station for the Wells Street Depot in Chicago. Three Edison incandescent and two Thomson-Houston arc dynamos will be driven by three Westinghouse engines, which combined with the old plant gives a total capacity of about 2,000 incandescent lights and 80 arc lamps. High grade insulated wire to the value of about $2,000 is yet to be purchased and also some conduit tubes.

General Sales Agent Sheldon, of the Schuyler Electric Company, rolled into Chicago on the Pennsylvania Limited last Friday, and immediately made his presence known by scooping in a goodly order for arc lights. Then he went over to the club and told the boys all about the big Schuyler search light that will shortly be placed on top of the Daily Moon building in New York, and focused on Chicago in order that the editorial staff, during the chief's absence in Europe, may maintain the same watchful regard for and cordial interest in Chicago's welfare that has been so pronounced a feature in that great sheet. General Sheldon also mentioned the special features in a number of lamps that are being supplied to the Navy department, two of which have attracted world wide attention.

Tacoma, Wash., July 12, 1892.

L. H. Griffith, of Seattle, has been elected superintendent of the Tacoma Railway and Motor Company.

Mr. H. A. Craigin has resigned his position as superintendent of the Tacoma Railway and Motor Company.

Leo Daft has returned to Seattle from his Eastern tour, having attended the convention of Electrical Engineers, in Chicago.

F. B. H. Paine is now receiver of the Belt Line Electric Railway at Port Townsend, Wash., which is controlled by the General Electric Company.

The City & Suburban Railway Company, of Portland, Ore., recently received a 500-h. p. multipolar Thomson-Houston generator, which is being placed in position.

Moscow, Idaho.—The electric lighting plant has been increased by a 500-light alternating dynamo and a 50-light arc machine, both of the Thomson-Houston type.

Chas. S. Bowie has installed on the Tacoma floating dry dock a system of electric indicators, of his own design, which shows the depth of water in the tanks used for submerging the dock.

Mr. C. Z. Mitchell is now district engineer for the Northwest Pacific Coast District of the General Electric Company. His headquarters are in Portland, Ore., and he is thoroughly familiar with his field.

The Union Electric Company, of Seattle, recently received two Edison 250-volt 133-h. p. generators, which will be placed in Station "A," and used to supply motors and elevators on commercial circuits.

The Spokane Electric Light Company, through Mr. Norman, has closed a contract with the Northwest General Electric Company for a 1,000-light alternating generator, to furnish lights for the outlying districts by the three-wire system.

The Union Trunk Line, of Seattle, has just received an additional Thomson-Houston generator, 240-h. p., multipolar type. This line has adopted Thomson-Houston W. P. car equipments, and has greatly reduced its fuel bill by using saw dust.

The Canadian Pacific Railway Company is reported to have decided upon the construction of an electric tramway from Vancouver, B. C., to Lulu Island, distance of 12 miles. The Fraser River will be bridged. Work will be commenced within 30 days.

The Rainier Power and Railway Company, of Seattle, has ordered six single reduction Edison type car equipments of 40 h. p. each. This company is proceeding steadily with its new railroad and lighting works. It has an unlimited supply of sawdust for fuel.

The Washington Electric Company, of Seattle, Fred E. Sander, president, is operating its incandescent lighting plant to its full capacity. Additional dynamos will be installed, either at the present station or at the new power house of the Grand Street Electric Railway Company.

Mr. E. B. Kittle, formerly head official for the Thomson-Houston Company in Seattle, is now special agent for the Northwest Pacific Coast District for the General Electric Company, and will have full charge of all railroad work and also all large lighting contracts. His headquarters will be in Portland, Ore.

The Point Defiance, Tacoma & Edison Railway Company, which is being changed into an electric line, Thomson-Houston system, has about half of its mileage in successful operation. Construction is being pushed rapidly on both ends, and the seven miles of road leading to Point Defiance Park will be operated entirely by electricity in a few days.

Election of the Tacoma Railway and Motor Company.—At the recent election Walker Oakes, J. M. Ashton, and T. B. Wallace resigned. The following directors were elected to succeed them: H. M. Byllesby, of St Paul; H. W. Goode, of Portland, and L. H Griffith, of Seattle. Paul Schulze was re-elected president, and H. W. Goode elected vice-president.

The Barnes Heights & Cornell Road Railway Company, of Portland, Ore., has closed a contract with the Northwest General Electric Company for three double 15-h. p motor car equipments and about 3¼ miles of line work, and is equipping the power station with an 80-h. p. generator and a "Russell" steam plant, having a capacity of 125 h. p. The work of grading the road is actively proceeding.

The General Electric Company has consolidated the branch offices in Seattle of the Thomson-Houston and Edison General Electric Company. The Northwest General Electric Company's headquarters for Puget Sound in Seattle, at 807 Front street, in charge of Mr. W. J Grambs, Portland, Ore., will be the headquarters for Oregon and Southern and Eastern Washington, a branch office in Spokane.

The Tacoma Railway and Motor Company will build ten new electric cars in Tacoma, and change six heavy cable cars into electric cars. New repair shops will be erected adjoining the power station. The company has ordered twenty 15-h. p. and twenty 20-h. p. car equipments of the Thomson-Houston single reduction type. A 900-h. p. tandem compound automatic engine is with being set up to run additional generators.

CANADIAN NOTES.

OTTAWA, July 12, 1892.

Toronto, Ont.—A report is current to the effect that the Davenport City and Suburban and Toronto Street Railway companies have amalgamated.

Sarnia, Ont.—The street railway company has added a baggage car to its rolling stock in anticipation of a large amount of business from the tunnel station.

Hamilton, Ont.—The electric street railway of this city, constructed by Messrs. Ahearn & Soper, of Ottawa, is now in full operation. The Westinghouse system, which Ahearn & Soper control in Canada, is used.

Waterloo, Ont.—The new building of the Ball Electric Light Company will be completed at an early date. The main building in 24x36 feet, boiler house 16x24 feet. It will be furnished with a 50-h. p. engine and boiler.

Vancouver, B. C.—An arrangement has been made by the Canadian Pacific Railway Company for the construction of a steam tramway from Vancouver to Lulu Island. The line has already been surveyed and the work of construction will commence within thirty days.

London, Ont.—C. H. Ivey, solicitor for the electric street railway, states that all the stock for the company, $150,000, has been applied for. Some of the applications were from outside parties. The form of agreement between his company and the city is being drawn up as quickly as possible, and will be ready for the next meeting of the finance committee.

London, Ont.—The Bell Telephone Company has submitted a proposition in which it is asked that the city agree not to permit any other company to establish a telephone system or agency in the city in consideration of which the telephone company agree to pay per year $800 to the city and to keep for the use of the city fire alarm wires free of charge the top cross arm of every pole to be erected.

Brantford, Ont.—Six hundred tons of rails and fish plates have arrived in the city for the electric street railway. Tenders will at once be asked for the construction of the road bed, and work is expected to be begun by next Saturday. Stock to the amount of $60,000 for the street railway has been submitted in Toronto. The names of the subscribers will be submitted to Brantford capitalists, and an opportunity given them to subscribe the balance of the stock, $40,000. If this is not done in a few days it will also be taken up in Toronto.

Brantford, Ont.—The city of Brantford has decided not to be outdone by many of its smaller sister towns and is going in for electric street lighting. Tenders will be received for lighting the streets and parks of the city to use 60 electric arc lights, more or less, of not less than 9.7 ampères, each machine to be of sufficient capacity to give at least 15 lights. The proposal to be for lighting for two, three and five years from Sept. 10, 1892, all night and every night. Separate tenders are also invited to furnish a complete electric plant to be put in ready for lighting and guaranteed to create at minimum capacity sufficient power to produce without strain the maximum number of lights, as stated above, burning all night and every night in the year, but to be run by the city only; also a tender to furnish a complete electric plant of the same capacity and put up as above, except that the city will agree to furnish all necessary motive power, but the whole plant to be run and owned by the city.

News of the Week.

THE TELEPHONE.

The Nebraska Telephone Company has completed a line from Omaha to Fremont. The service extends to El horn, Millard, Waterloo and Valley.

New London, Conn.—Efforts are being made to raise the cable between Fisher's Island and New London. A new cable will be laid in a few days.

Darlington, Ill., has been connected by a new telephone line with Shulisburg, New Diggins, Lead Mine and Benton.

The New England Telephone and Telegraph Company, of Lowell, Mass., is erecting a new 60-wire cable, 3,000 feet long.

New York.—The cable between Ellis Island and the Barge Office has been laid. It has four connections, two to be used for telephones, one of the telegraph and one to be held in reserve.

THE ELECTRIC LIGHT.

Fairbury, Ia., has contracted for electric lights.

Lansing, Mich., has voted to issue $60,000 worth of bonds for an electric light plant.

Casselton, N. Dak., is considering the advisability of having an electric light plant.

Iowa Falls, Ia.—A company has been organized with $15,000 capital, and has obtained a franchise for a number of years.

West Newton, Pa.—Irwin capitalists are arranging for the erection of an electric light plant at West Newton at a cost of $25,000.

New Orleans, La.—The Algiers Ice Manufacturing Electric Light Company expects to have its plant in working order by Aug. 1.

Stafford Springs, Conn.—The Stafford Springs Electric Light Company has turned on its light, and its plant is now in successful operation.

Fenton, Mich.—The Fenton Electric Light Company has purchased a new site and expects to erect a new electric light plant at a cost of about $10,000.

The Lemont (Ill.) Electric Light Company has secured a village franchise and will immediately erect a plant for both arc and incandescent lights.

Oswego Falls, N. Y.—A special meeting of the taxpayers was held on July 12 for the purpose of raising $1,000 to pay for electric lights in the village streets.

Cedar Rapids, Ia.—A Reynolds-Corliss 350-h. p. engine and a Thomson-Houston 200 k. w. generator are to be added to the equipment of the electric railway plant.

Woonsocket, R. I.—The mayor has signed a resolution authorizing the making of a five years' contract with the Woonsocket Electric Machine and Power Company for lighting the city streets.

Detroit, Mich.—The executive committee of the Detroit Exposition has authorized the closing of a contract with the Commercial Electric Company for the lighting of the exposition buildings and grounds.

Buckley, Wash.—The Buckley Electrical Company has secured a fifty years' franchise for an electric light system, and a plant with a capacity of 20 arc and 220 incandescent lights is being constructed.

Chicago, Ill.—Supt. Barrett says that with the funds at his disposal it will be impossible to make the necessary extensions in the city's electric lighting, and that the only way to accomplish this is by special assessments.

Altata, Ala.—Hartford, Herbert & Co., contractors for the Attalla water-works and electric light plant, has finished its works to the satisfaction of all the city officials and on July 13 the plant was accepted by the city board.

Chattanooga, Tenn.—Experiments with incandescent lights as signals are in progress on Cincinnati, Hamilton & Dayton Railway and 12 engines are equipped with electric headlights, which are said to give great satisfaction.

Danville, Ill.—The Danville Woolen Mills have closed a contract with the Thomson-Houston company for an incandescent electric light plant to be installed in the mills immediately. Ninety lamps will be used at first, although the capacity of the plant is to be 250.

Duluth, Minn.—All the electric light and power interests have been consolidated, including the Duluth Electric Light and Power Company, the Hartman Electric Company and the Northern Subway Company. The new company will be known as the Hartman General Electric Light Company, with a capital of $500,000.

THE ELECTRIC RAILWAY.

Washington, D. C.—Bids have been opened for the construction of the Mt. Vernon Electric Railway.

Brooklyn, N. Y.—Several rival companies are making a sharp fight to secure the privilege of installing a trolley road on Union street.

Brooklyn, N. Y.—The Kings County Elevated Railroad has decided to operate its trains by electricity. It is understood that the storage battery system is to be used.

A Silver Spike.—The work of converting the New Orleans and Carrolton (La.) horse railway into an electric railway was inaugurated last week by the driving of a silver spike by Mr. A. L. Abbott.

St. Louis, Mo.—It is reported that an elevated electric road will be constructed soon between St. Louis and Meramec. The elevated structure will extend as far out as Webster Grove, and the estimated cost is $450,000.

Trenton, N. J.—The Paterson Central, The Peoples' Park Railway and the Paterson Railway Company have petitioned the subway commission for permission to erect poles and operate their roads by the trolley system.

Haverhill, Mass.—The directors of the Haverhill & Groveland Street Railway Company at a recent meeting voted to accept the terms of the charter granted by the board of aldermen of Haverhill, for the use of electricity and a double track system.

New York.—The State Board of Railroad Commissioners has approved the application of the Second Avenue Railroad Company, of New York City, for permission to use the electrical storage battery system of propulsion for its cars in Second avenue from Harlem river to Tenth street and thence through Stuyvesant street to Astor place.

LEGAL NOTES.

Baltimore, Md.—A bill has been filed in the Circuit Court against the Chesapeake & Potomac Telephone Company, in which the plaintiff, A. F. Lawrence & Co., asks the Court to restrain the telephone company from removing two instruments for which the legal rate of $66 had been tendered under the law passed by the last legislature, and which amount the company refused to accept under its interpretation of of the law, Lawrence & Co. not being on a wire on which there were other subscribers.

The Canton Steel Roofing Company Wins.—In the suit of the U. S. Court of the Canton Steel Roofing Company vs. Alvin C. and William Kanneberg, as the Kanneberg Roofing Company, for infringement of patent on sheet metal roofing, the Court has decided that the roofing manufactured by the Kanneberg Roofing Company is an infringement upon patents owned by The Canton Steel Roofing Company, of Canton, O., and the Kanneberg Roofing Company is perpetually enjoined from the manufacture of said roofing.

St. Louis, Mo.—In the Court of Criminal Correction, Gustave A. Temple, charged with stealing electric current from the Missouri Electric Light and Power Company, was discharged. The decision practically means that electricity cannot be stolen. In his preliminary trial Judge Claiborne held the charge of petit larceny to be untenable, and changed the information to attempted fraud. The Grand Jury reversed Judge Claiborne, and remanded the case back, rechangining the charge to petit larceny. Temple's attorney filed a plea in bar, and this motion was upheld, Judge Claiborne holding the defendant had been cleared of the charge at a previous sitting, and ordered the defendant's discharge.

Litigation Over Commercial Cable Company's Stock.—John W. Mackay and James Gordon Bennett are made the defendants in a suit brought by Count Arthur Dillon in the Supreme Court in New York. The count alleges that a contract was made with him by which he was to receive as a bonus one-third of 800 shares of preferred stock that was to be issued and guaranteed a dividend of 15 per cent. He says the stock was never issued by the company, and he now wants not only his share, as it would have been if issued, and the dividends, but the proportionate addition that would have been made to it by the increase of the capitalization. He says the capital was first increased from $4,000,000 to $6,000,000 and then to $10,000,000.

Chicago, Ill.—Judge Collins has dismissed the bill of C. B Farwell *et. al.* against the Great Western Telegraph Company, *et. al.*, after an exhaustive hearing, for want of equity. This was the second bill filed by stockholders to set aside the decree of 35 per cent. assessment against the stockholders of the company for the payment of the debts of the company, now amounting to over $500,000. The present bill charges fraud and various other things as a ground to set aside the assessment. The complainants secured a favorable report from the Master in Chancery, but Judge Collins of the Circuit Court upon full view held that upon the evidence taken before the Master in Chancery as well as upon the pleadings, the bill will not be sustained. This decision affects 3,000 stockholders scattered through the Northwest.

Taxation of Electric Companies in New York.—Under Laws 1880, c. 542, sections 3, 11, as amended by Laws 1885, c. 501, providing that every domestic corporation shall pay an annual tax upon the value of its capital stock employed within th is State an electric light company, conveying to various companies outside the State the right to use its patents, and receiving payment therefor in the stock of such companies, is a mere investor in this stock and the capital thus invested is not exempt In order to be exempt the capital must be "employed"—that is, "used," "kept at work," outside the State. Capital invested in patents is to be deemed employed in the State where the company is located, and, although its patent-rights extended over the United States and other countries, if it is so located here it is a New York corporation, and a claim that it can be taxed only for the proportionate value of its patents in this State is untenable. This decision was given in the case of the Edison Electric Light Company vs. Wemple, collector, in the Supreme Court of New York.

PERSONALS.

Mr. Thomas A. Edison has subscribed $1,000 for the new Press Club building, to be erected in New York City at a cost of $100,000.

Mr. Robb Mackie has been appointed to the position of city electrician of Cincinnati. His office is still in the temporary building on Fourth street near Central avenue.

MISCELLANEOUS NOTES.

Schenectady, N. Y.—The plant of the General Electric Company is to be enlarged by the erection of three new buildings.

New Orleans, La.—A fire occurred in the Western Union Telegraph office on the night of July 10, which resulted in damages to the extent of about $5,000.

Struck by Lightning and Recovered.—The report comes from Johnstown, Pa., that on July 15 John Bloom, while in his own house, was struck by lightning and was rendered unconscious for about an hour. The sight of one eye was destroyed, his hair and moustache burned, and a mark was left down the side of his body as far as the knee. A hole was burned in the flesh just above the knee.

Trenton, N. J.—The Electrical Subway Commission adopted resolutions requiring all companies desiring to erect wires over streets in cities of this State to make application to them, and failure to comply with this will make the erection of wires illegal. They also decided to place all telephone, telegraph and cable wires in Jersey City and Newark underground, and they will sit on Sept. 6 to hear matters relating to the placing of wires underground.

Where was the editor when the office boy of the Elkhart (Ind.) *Review* composed the following advice for central station architects? The editorial columns of that journal contain this paragraph: "A mishap occurred to the electric light plant at Valparaiso that is very suggestive. Soon after the plant was closed for the night a terrific explosion occurred, wrecking the building and causing a destructive fire. One of the great dynamos was torn from its place by the explosion. It is likely that precisely the same conditions were existing in the room that result in electrical displays in the open air, and the explosion was probably nothing more nor less than an electric discharge like a flash of lightning in a rain cloud. The incident suggests the necessity of providing for plenty of ventilation in electric light plants, to prevent the electric condition of the atmosphere becoming too marked in confined space." Very suggestive, indeed!

Industrial and Trade Notes.

The New York Electrical Supply Company is furnishing the supplies for the Barry & McTighe electric road in Brooklyn.

The Albany Lubricating Company reports success with its compound oils, which give excellent satisfaction wherever used.

The Consolidated Temperature Controlling Company, of Minneapolis, Minn., has changed its corporate name to the Electric Thermostat Company. The company will continue under its present management.

The Gethins Electrical Manufacturing Company, 620 Atlantic avenue, Boston, Mass., has issued a neat catalogue of general battery and motor supplies. The various cells and batteries controlled by this company are fully illustrated and described.

New Lightning Arrester.—Referring to the great amount of trouble experienced this season on electric roads from lightning, the Railway Equipment Company, Chicago, announces that it is about ready to place on the market a lightning arrester, possessing, it is claimed, unusual merit for station, car and line use.

The Brush Electric Company has received from Manilla on the Phillipine Islands, through its agents, Messrs. Bagnall & Hilles, of Yokahoma, an order for a 1,000-light alternating current dynamo, 1,000 lamps, key-sockets and switches; 1,000 light capacity of converters, slate switchboard, exciter and 125-h. p. engine and boiler. This is the first shipment ever made direct from America to Manilla.

The Forrest Silver Bronze Packing Company, 115 Liberty street., N. Y., is sending out a little pamphlet containing a

general description of its silver bronze rod packing, accompanied by some very excellent testimonials. The high pressures which are used in modern engines demand some substantial packing. The metal packings commonly used generally require to be helped out by some sort of soft packing, but the Silver Bronze packing it is claimed, is entirely sufficient in itself. It seems to find special favor in marine work where high pressures are common.

Electrical Fibre Carbon Company is the name of a new company that has entered the field of carbon supplies and established itself at 1228-1234 Michigan avenue, Detroit, Mich. The company manufactures round, square, fluted, solid, hollow and cored carbons, carbon plugs for the production of aluminum, commutator brushes, carbon cups and buttons, carbon rheostats of any resistance and all the supplies for primary batteries. It appears to be handling an excellent thing and will no doubt find ready sales for its supplies.

Mr. Norman Hubbard, of 93 Pearl street, Brooklyn, N. Y., manufacturer of the Packard vacuum pump, which is so well known in connection with the manufacture of incandescent lamps, has recently supplied one No. 3 pump to the Edison Lamp Company, Harrison, N. J., and one No. 3 and one No. 4 to the Dominion Electric Company, Montreal. Mr. Hubbard informs us that there are now more than 150 of these pumps in use in this country and abroad, and that recent improvements of very great value have been made in them.

The Berlin Iron Bridge Company, of East Berlin, Conn., has received the contract for the new tin plate works which Hughes & Patterson are to erect at Philadelphia, Pa. The buildings will be of iron, from the designs of the Berlin company. The main building will be 40 feet wide by 253 feet long, with a wing of the same width 300 feet long, both two stories high. The rolling mill will be 120 feet wide by 160 feet long, with an annealing room 75 feet wide by 160 feet long. The whole plant will require about 800 tons of iron to be used in its construction.

The Queen Resistance Testing Sets.—Queen & Co., Philadelphia, report an unusual demand for their standard portable testing sets, as the distinctive merits of these goods make them very popular. In every central station, no matter how small, it is real economy to have accurate apparatus for measuring resistance of lines, dynamos, lamps, etc., and the Queen set, "1891" type, with its wide range, accurate adjustment and dead beat galvanometer is said to prove wonderfully efficient. Although introduced less than one year ago it is to be found all over the country, and indications point to a steady and increasing demand. Queen & Co. guarantee these sets absolutely correct to one-fifth of one per cent.

The Electric Launch and Navigation Company, of New York, is pleased with the result of the official test of the electric launches which recently took place at Jackson Park, Chicago. Each boat was required to make a ten hours' run over a prescribed course, making designated landings. Two boats entered, the "Electra," owned by the Electric Launch and Navigation Company, of New York, and a boat not named, built by the Columbian Launch Company, of Chicago. The "Electra" made forty-five trips, at the rate of eleven and a quarter minutes per trip. Subsequently, a test of several cells of battery taken at random from the two boats, was made. The cells were charged as fully as the contestants desired and then discharged at the uniform rate of 16 ampères. The Consolidated Company's batteries of the "Electra" were charged 116 ampère hours, and gave a discharge of 137.

Recent Sales made by the Sioux City Engine Works are the following: One 12 by 18 Giddings automatic boiler and complete plant for Chadron Electric Light Company, Chadron, Neb.; five 5½ and 9 by 14 Giddings' automatic compound engines to G. Y. Bonus, for steam milling plants; also five 6½ and 11 by 16 Giddings automatic compound engines to G. Y. Bonus for steam milling plants, and one 12 by 20 by 30 to G. Y. Bonus for milling plant; one 12 by 30 Corliss boiler and complete steam plant to Diamond Iron Works., Minneapolis; one 12 by 30 Corliss to Stratton & White, Fort Worth, Tex.; one 12 by 30 Corliss to Brookman & Barrett, Vermillion, S. Dak.; one 16 by 30 Corliss to the Joliet Enterprise Company, Joliet, Ill.; one 20 by 43 Corliss to the Salem Electric Light & Power Company, Salem, Ore.; one 12 by 36 Corliss to Cavalier Roller Mill Company, Cavalier, N. Dak.; one 11 by 18 Giddings automatic to Corvallis Roller Mill Company, Corvallis, Ore, and one 12 by 36 Corliss to Crouch Bros., St. Edwards, Neb. The company reports a decided increase in the demand for engines since the 20th of June, and has every prospect for a very large demand for its engines during the balance of the season, and in anticipation of this, it has completed a number of standard selling sizes, ready for prompt delivery, and is now engaging additional force for a night gang to take car of rush orders on hand.

Warren Webster & Co., manufacturer of the Webster vacuum feed water heater and purifier, 491 N. Third street, Philadelphia, Pa., during the past few weeks has received among others the following orders: Edison Light and Power Company, San Francisco, Cal., one 1,500 h. p.; Armour Packing Company, Kansas City, Mo., one 1,500 h. p.; Standard Kiln Dried Lumber Company, Norfolk, Va., one 500 h. p.; Armour Industrial School, Chicago, Ill., one 500 h. p.; American Tube and Iron Company, Middletown, Pa., one 1,500 h. p.; Central Iron Works, Harrisburg, Pa., one 1,000 h. p.; Illinois Steel Company, Milwaukee, Wis., one 1,500 h. p.; Asbury Park Electric Light and Power Company, Asbury Park, N. J., one 600 h. p.; St. Augustine Gas and Electric Light and Power Company, St. Augustine, Fla., one 40 h. p.; Allentown Gas Company, Allentown, Pa., one 40 h. p.; Cleveland Rolling Mill Company, Cleveland, O., one 3,000 h. p. (fifth order); Anhauser-Busch Brewing Association, St. Louis, Mo., one 1,500 h. p.; Edison Illuminating Company, Detroit, Mich, one 1,500 h. p., etc. In regard to the patent for feed water heater No. 75,992, dating May 31, 1892, the first one put into practical operation was a 500 h. p. used in connection with a pair of compound engines at the steam plant of W. F. & F. G. Sayles, Saylesville, R. I. The second was also a 500 h. p. furnished upon trial to the Merrick Thread Company, of Holyoke, Mass. The company has also received orders from the following parties for the Williams vacuum system of steam heating during the past few weeks: Royal Baking Powder Company, New York; Basch & Greenfield, Newark, N. J.; Eureka Fire Hose Company, Brooklyn, N. Y.; Alsip Brick Company, Chicago, Ill.; Lowenberg Knitting Company, Norfolk, Va.; Armour Industrial School, Chicago, Ill.; Ostrander Fire-Brick Company, Ostrander, N. J.; Brunswick, Blake-Collender Company, Chicago, Ill.; De La Vergne Refrigerating Company, New York.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

The New York Office of the Consolidated Electric Storage Company, 120 Broadway, is the sole agency for the sale of storage batteries for New York and vicinity. Purchasers desiring to secure the best terms should apply at this office to E. J. Moore, manager.

Two Harvest Excursions—Half Rates to the West.—August 30 and September 27—on these dates the Burlington Route will sell tickets from Chicago, Peoria and St. Louis to the farming districts of Nebraska, Colorado and Northern Kansas. Half rates will apply, and tickets will be good for 20 days. Nebraska in one year produced 300,000,000 bushels of corn, besides other grain, fruits and live stock. Write for free pamphlets, etc., to P. S. Eustis, G. P. A., Burlington Route, Chicago, Ill.

A Reference Book of Great Value.—In a recent communication to The Electrical World, Mr. Wm. S. Rose, of Pulaski, Tenn., gives the following opinion regarding "Houston's Dictionary of Electrical Words, Terms and Phrases": "Houston's new dictionary was duly received. I consider it a reference book of great value to all persons interested in electrical study. Its definitions of words and terms are so well and plainly expressed that the young student, as well as the old, can understand their meaning. It is more than a dictionary—a book of varied electrical information, which all who procure a volume will appreciate."

Pullman Vestibuled Buffet Sleeping Car Service—Chicago to Portland, Me.—Commencing June 26, and continuing through the tourist season, the Chicago & Grand Trunk Railway will run a Pullman vestibuled buffet sleeping car of the most modern pattern, through without change, from Chicago to Portland, via Toronto and Montreal, leaving Chicago 3 P. M. daily except Saturday, arriving at Portland for breakfast second morning. On this train there will be a Pullman car for Old Orchard Beach, and tourists for all North Atlantic seaside and mountain resorts will find this improved through service worthy of patronage. Secure sleeping car reservations and further information by applying to E. H. Hughes, General Western Passenger Agent, No. 103 S. Clark street, Chicago.

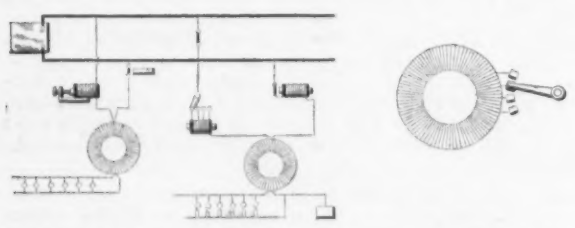
Summer in Colorado.—If you are calculating on spending your summer vacation in Colorado you should consider the most comfortable way to get there. The handsomest train in the world runs daily from Chicago to Pueblo, Colorado Springs, Manitou and Denver, without change, over the Santa Fé Route. There is no other through car line to Manitou, the great Colorado resort. You must transfer and change cars if you go any way other than over the Santa Fé Route from Chicago. Don't forget this, it is an important fact. A through car runs on through Manitou, Ute Pass, Cascade Canon, Green Mountain Falls, Buena Vista and Glenwood Springs to Ogden and Salt Lake City, without change from Chicago. On any other line you can't do it. For further information address J. M. Connell, City Passenger Agent, 212 Clark street, Chicago.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED JULY 12, 1892.

478,551. Magnetic Separator; Clinton M Ball, Troy, N. Y. Application filed Oct. 12, 1891. An ore separator comprising a plurality of separating surfaces and a magnetic field or fields in operative relation thereto, respectively, the said field extending between adjacent separating surfaces and assisting magnetically in the transfer of partially separated ore from one surface to the other.



No. 478,722.—Distribution of Electric Currents.

478,591. Electric Locomotive; Joshua Gray, Medford, Mass. Application filed June 12, 1891. The combination, with an axle of a car, of a bolt or bearing extending vertically from the axle, a bevel gear mounted on the axle, a bevel pinion mounted on the bolt, a gear wheel also mounted on the bolt, an electric motor mounted on the top portion of the car and a vertical shaft connecting the armature of the motor with the gear wheel on the bolt.

478,629. Electric Rail Bond; Thomas J. McTighe, New York. Application filed April 1, 1892. The combination, with a girder rail joint of a rail bond having its ends inserted upwardly through holes in the arms of the adjoining rails and within the lengths of fish plates and riveted on top.

478,643. Method of Welding Metal Wheels; Emmett H. Scott, La Porte, Ind. Application filed Jan. 28, 1889. The process of securing metal spokes in the rims of metal wheels, consisting in first putting the spoke in place within the rim, then heating the end of the spoke in contact with the rim to a welding heat and holding the rim and the spoke together under pressure, and thus welding them together.

478,644. Method of Making Metal Wheels; Emmett H. Scott, La Porte, Ind. Application filed Jan. 28, 1889. The improvement in the art or process of making metallic wheels, consisting in first securing the spokes rigidly in the metal rim of the wheel and inserting them in place in the hub, then forcing or clamping the rim of the wheel to a tire circle about the axis of the hub, then heating the ends of the spokes by an electric current to the fusing or welding point, and, finally, subjecting the ends of the spokes to force or pressure while so heated to unite them with the hub.

478,661. Electrode for Storage Batteries; Henri Tudor, Rosport, Luxemburg. Application filed Jan. 8, 1892. An electrode for electric storage batteries, consisting of a core composed of one or more bodies of metal having main ribs which are provided with secondary ribs forming between them grooves, and operative substance embedded in the grooves.

478,664. Electrode; Armand Vanden Kerckhove, Brussels, Belgium. Application filed Feb. 12, 1892. An electrode plate consisting of a grating and electrodes each secured to the grating by soldering on one of its sides and by lugs and projections on one of its other sides, thereby allowing space on three of its sides for the expansion and contraction thereof.

478,689. Cut-Out Switch; William B. Cleveland, Geneva, O. Application filed Sept 21, 1891. The combination of stationary contacts, a pivot projecting from one of the contacts, a lever provided with registering contacts and having an eye projecting from the end of one of the contacts and detachably pivoted, upon the pivot and a fuse connected to the lever contacts.

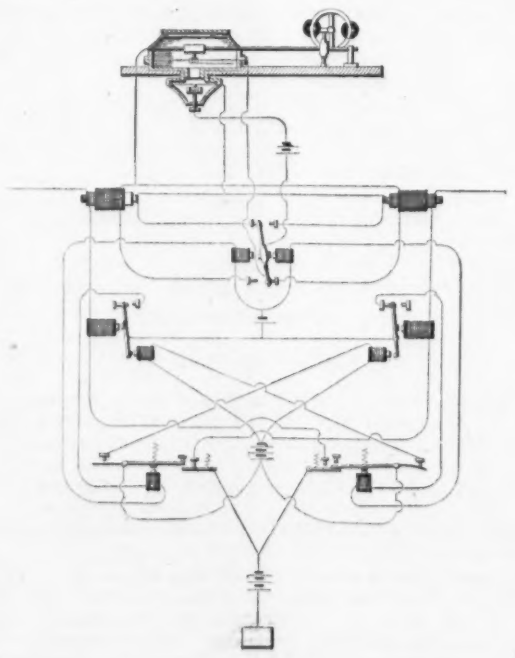
478,692. Telephone; Paul H. D'Unger, Chicago, Ill. Application filed Mar. 29, 1892. In the diaphragm of a telephone an arm projecting over the diaphragm, a screw in the arm, and a buffer actuated by the screw and adapted to bear against the diaphragm.

478,701. Thermal Alarm; Hosea Frank Maxim and Jesse M. Price, Norfolk, Va. Application filed Jan. 7, 1891. In a thermal-alarm mechanism, the combination, with a mercury tube having a contact or conductor permanently connected with the mercury and a series of contacts normally above the mercury and extending from the mercury chamber to the outside surface, and a non-conducting back or support, of a series of pairs of terminals carried by the back or support extending along the tube, the terminals of each pair being insulated from each other and one being connected to a tube contact and the other to a battery wire and a removable pin adapted to be clamped between the terminals of one of the pairs.

478,718. Arc Extinguisher for Electric Switches; Sidney H. Short, Cleveland, O. Application filed March 10, 1891. In a switch or circuit controller, the combination, with a switch lever and a series of contacts and resistances, of an arc extinguisher consisting of a series of supplemental contacts, each being a good conductor of heat and electricity and arranged in the path of the switch lever.

478,722. Distribution of Electric Currents; Elihu Thomson, Swampscott, Mass. Application filed Dec. 6, 1886. The combination of a main or principal circuit, a local or independent circuit, an induction apparatus between the two, and a fusible plug in the connection from the main to the induction apparatus. (See illustration.)

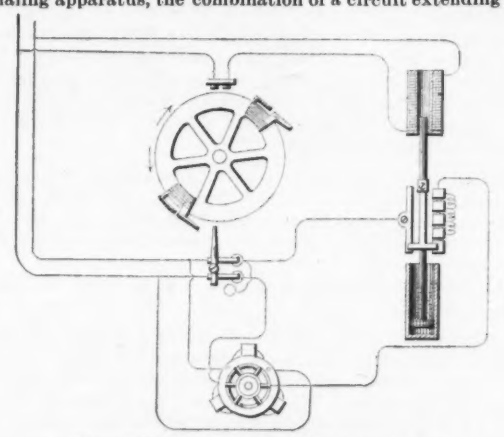
478,743. Telephone Repeater; Thomas A. Edison, Menlo Park, N. J. Application filed Oct. 14, 1885. The combination, with a telephone line, of two or more reciprocal telephone repeaters connected therewith, and switches at the telephone repeater controlling the direction of transmission and operated successively from either end of the line, and each repeater containing a switching circuit controller in each line section. (See illustration.)



No. 478,743.—Telephone Repeater.

478,788. Electrical Thermostat; William L. Denio, Rochester, N. Y. Application filed Dec. 8, 1891. An insulator, electrodes and thimbles attached to one of the electrodes and secured together by solder fusible at a given temperature, a spring between the thimbles which tends to throw the outer thimble off, a shoulder on the outer thimble, and a spring attached to an electrode and bearing against the outer thimble.

478,789. Electric Signaling Apparatus; William L. Denio, Rochester, N. Y. Application filed Dec. 8, 1891. In an electric signaling apparatus, the combination of a circuit extending from



No. 478,821.—Electric Elevator.

the central station to the sub-station, a signaling mechanism, a shunt connected with the circuit, an electromagnet for releasing and setting in motion the signaling mechanism, the magnet being connected with the shunt connections of the circuit, whereby the signal mechanism at the central station, an electromagnet for releasing the registering mechanism, another electromagnet connected with the main line for operating a local circuit, and a local circuit connecting the last named two magnets, the whole so arranged, that the parting or other disarrangement of the wires at the sub-station, whereby the circuit is broken, will be indicated at the central station without sounding an alarm of fire.

478,816. Electro-Mechanical Apparatus for Starting or Reversing Machinery; Albert Piat, Paris, France. Application filed April 2, 1890. In machines actuated by an electric motor, the combination, with a lever for controlling the current and motor, a contact arranged on the under side of the lever, fixed contacts arranged on each side of the lever and in the path of the contact, hinged levers and springs whereby a movement of the lever will cause the contact on the under side of the lever for controlling the current to move under and raise one of the hinges until it shall have been passed, and a reverse movement of the lever will cause it to travel above the contact.

478,821. Electric Elevator; Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y. Application filed March 14, 1892. The combination of an elevator car, a motor therefor, a switch and rheostat in the motor circuit, a solenoid in a seperate circuit, the solenoid moving the switch and rheostat, a retarding device for the solenoid, a switch in the circuit with the solenoid, and mechanical connections from the car to the switch in the solenoid circuit. (See illustration.)

478,956. Conduit System for Electric Railways; William H. Ford, St. Louis, Mo. Application filed July 6, 1891. In a conduit electric railway, a pneumatic chamber consisting of a shell having an upper portion impermeable to water or air, and a lower end open to the atmosphere, a body of insulating material located in the upper portion of the chamber at a distance from the open end thereof, and a vertical supporting pin upon which the body of the insulating material is mounted, in combination with a main insulated conductor and a bare conductor, between which the pneumatic chamber is located, and a conducting wire passing from the main conductor up through the pneumatic chamber to the bare conductor.

478,968. Electric Motor; Harlon F. Ong, Newberg, Ore. Application filed April 4, 1891. In an electric motor, the combination of an armature formed of a number of sections and provided with a commutator, a field magnet formed of a number of sections corresponding with those of the armature and a multiple switch for sending the current through one or more of the field-magnet sections in either direction.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.